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JPL BIBLIOGRAPHY 39-20

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Publications of the Jet Propulsion Laboratory 1978

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April 1, 1979

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California



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JPL BIBLIOGRAPHY 39-20

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Foreword

JPL Bibliography 39-20 describes and indexes the externally distributed technical reporting, released during calendar year 1978, that resulted from scientific and engineering work performed, or managed, by the Jet Propulsion Laboratory. Six classes of publications are included:

- (1) JPL Publications (77-, 78-, 79-series, etc.), in which the information is complete for a specific accomplishment and can be tailored to wide or limited audiences and be presented in an established standard format or special format to meet unique requirements.
- (2) Articles published in the open literature.
- (3) Articles from the bimonthly *Deep Space Network (DSN) Progress Report* (42-series). Each collection of articles in this class of publication beginning with 42-20 presents a periodical survey of current accomplishments by the Deep Space Network. Formerly, each collection of articles was published as a separate volume of Technical Report 32-1526.
- (4) Technical Reports (32-series), in which the information is complete for a specific accomplishment and is intended for a wide audience.
- (5) Technical Memorandums (33-series), in which the information is complete for a specific accomplishment but is intended for a limited audience to satisfy unique requirements.
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Contents

| | |
|------------------------------------|------------|
| Author Index With Abstracts | 1 |
| Subject Index | 145 |
| Publication Index | 178 |

Author Index With Abstracts

ABRAMS, M. J.

A001 Evaluation of Landsat MSS vs TM Simulated Data for Distinguishing "Hydrothermal Alteration"

M. J. Abrams, A. B. Kahle, D. P. Madura, and J. M. Soha

JPL Publication 77-83, March 1, 1978

The object of this study was to simulate Landsat Follow-On (LFO) data to demonstrate the mineral exploration capability of this prospective system for segregating different types of hydrothermal alteration and to compare this capability with that of the existing Landsat system

Multispectral data were acquired for several test sites with the Bendix 24-channel MSDS scanner. This instrument had spectral bands closely approximating those of the LFO. The data were geometrically corrected, noise was removed, and resolution was degraded to LFO parameters prior to further computer processing. Contrast enhancements, band ratioing, and principal component transformations were used to process the simulated LFO data for analysis.

For the Red Mountain, Arizona, test area, the LFO data allowed identification of silicified areas, not identifiable with Landsat 1 and 2 data. In addition, the improved LFO resolution allowed detection of small silicic outcrops and of a narrow silicified dike. For the Cuprite-Ralston, Nevada, test area, the LFO spectral bands allowed discrimination of argillic and opalized altered areas; these could not be spectrally discriminated using Landsat 1 and 2 data. Addition of data from the 1.3- and 2.2- μm regions allowed better discriminations of hydrothermal alteration types.

A002 Computer Image Processing—Geologic Applications

M. J. Abrams

JPL Publication 78-34, June 1, 1978

Computer image processing of digital data was performed to support several geological studies. The specific goals were to (1) relate the mineral content to the spectral reflectance of certain geologic materials, (2) determine the influence of environmental factors, such as atmosphere and vegetation, and (3) improve image processing techniques.

For detection of spectral differences related to mineralogy we found the technique of band ratioing to be the most useful. Ratio pictures exaggerate subtle color dif-

ferences and, to the first order, suppress albedo differences due to topography.

The influence of atmospheric scattering and methods to correct for the scattering were also studied. Two techniques were used to correct for atmospheric effects: (1) dark object subtraction, (2) normalization by use of ground spectral measurements. Of the two, the first technique proved to be the most successful for removing the effects of atmospheric scattering.

Finally, a digital mosaic was produced from two side-lapping Landsat frames. The advantages were that the same enhancement algorithm can be applied to both frames, and there is no seam where the two images are joined. Disadvantages included the time-consuming process of doing the mosaicking and the fact that the enhancement algorithms may not be optimal for both scenes, but are a compromise.

A003 A Study of Alteration Associated With Uranium Occurrences in Sandstone and Its Detection by Remote Sensing Methods

J. E. Conel, M. J. Abrams, and A. F. H. Goetz

JPL Publication 78-66, Vols. I and II, August 1, 1978

For abstract, see Conel, J. E.

ADAMS, M.

A004 A Statistical, Micromechanical Theory of the Compressive Strength of Brittle Materials

M. Adams and G. Sines

J. Amer. Ceram. Soc., Vol. 61, No. 3-4, pp. 126-131, March-April 1978

A general theory of the compressive strength of brittle materials is presented. This theory proposes that failure is brought about by structural weakening from accumulated crack damage which increases with the stress level. The statistics of the flaw distribution and the mechanism of crack initiation and extension are important. A sample calculation using the theory is given to demonstrate its application.

A005 Crack Extension From Flaws in a Brittle Material Subjected to Compression

M. Adams and G. Sines

Tectonophysics, Vol 49, pp 97-118, 1978

The mechanisms by which cracks extend from flaws in brittle materials subjected to compressive loads are presented. Although it is recognized that most geological materials are neither dense nor single-phase, this experimental study and analysis are restricted to single-phase, dense materials in order to provide a model amenable to analysis and experimental confirmation. The flaws which occur in dense, single-phase materials are divided into three types, each type having different characteristics of crack extension. Experimental studies of crack extension from flaws introduced into blocks of polymethylmethacrylate plastic are described. The studies show that crack extension from three-dimensional flaws is more complex than two-dimensional theories predict. The extension of secondary cracks may result in more damage than that which would be predicted by considering only the primary crack extension treated by current theories. The importance of the dynamic behavior of flaws which stick and then suddenly slip is shown.

ADAMS, M. J.

A006 Orbit Trim Maneuver Design and Implementation for the 1975 Mars Viking Mission

G. R. Hintz, D. L. Farless, and M. J. Adams

Preprint 78-1394, AIAA/AAS Astrodyn Conf, Palo Alto, Calif, August 7-9, 1978

For abstract, see Hintz, G. R.

ADAMSKI, T. P.

A007 Pioneer Mission Support

T. P. Adamski

The Deep Space Network Progress Report 42-44 January and February 1978, pp 44-49, April 15, 1978

This article reports on activities within the Deep Space Network in support of the Pioneer Project's in-flight spacecraft during the period August 1977 through January 1978. The amount of tracking coverage provided by the Network and a summary of operational testing of the Mark III Data Subsystems at DSSs 42/43 and 61/63 are presented.

ADDINGTON, J. D.

A008 An Interactive Lake Survey Program

A. Y. Smith and J. D. Addington

Proc SPIE, Vol 119, pp 21-27, 1977

For abstract, see Smith, A. Y.

AJELLO, J. M.

A009 An Interpretation of Mariner 10 Helium (584 Å) and Hydrogen (1216 Å) Interplanetary Emission Observations

J. M. Ajello

Astrophys J, Vol 222, pp 1068-1079, June 15, 1978

The Mariner 10 ultraviolet spectrometer measured the interplanetary emissions of both He(584 Å) and H(1216 Å) on January 28, 1974 at time of solar minimum. The heliocentric distance was 0.75 AU. A first analysis of the observations by a simple model, which employs the Copernicus satellite measurement for the velocity of the interstellar wind of $22 \pm 3 \text{ km s}^{-1}$, shows that a simultaneous measurement of both emissions results in a self-consistent determination of the physical properties of the interstellar wind. The interstellar wind parameters found by comparison of a model with the observations showed the number densities of helium and hydrogen outside the solar system were $0.008 \pm 0.003 \text{ cm}^{-3}$ and $0.04 (+0.03, -0.02) \text{ cm}^{-3}$, respectively, which results in a He/H ratio of $0.20 (+0.30, -0.13)$. The helium cone produced by solar gravitational focusing has a full width at half-maximum of 35° measured from the Sun. An analysis of the profile of the downwind helium cone showed that the temperature of the interstellar wind was $15 \pm 8 \times 10^3 \text{ K}$. The effective lifetime of the hydrogen atoms in the solar system, for the model presented here, was $2.8 \pm 0.4 \times 10^6 \text{ s}$. The downstream direction of the interstellar wind found from the direction of the $L\alpha$ minimum and corrected for parallax was $\alpha = 72^\circ$, $\delta = 17^\circ$ with a $\pm 5^\circ$ uncertainty.

A010 The Composition of Phobos: Evidence for a Carbonaceous Chondrite Surface From Spectral Analysis

K. D. Pang (Planetary Science Institute),
J. B. Pollack (Ames Research Center),
J. Veverka (Cornell University), A. L. Lane, and
J. M. Ajello

Science, Vol 199, pp 64-66, January 6, 1978

For abstract, see Pang, K. D.

A011 Multicolor Observations of Phobos With the Viking Lander Cameras: Evidence for a Carbonaceous Chondritic Composition

J. B. Pollack (Ames Research Center),
J. Veverka (Cornell University), K. Pang (Planetary
Science Institute), D. Colburn (Ames Research
Center), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp 66-69, January 6, 1978

For abstract, see Pollack, J. B.

ALBERDA, M. E.

A012 Implementation of Automated Fault Isolation Test Programs for Maximum Likelihood Convolutional Decoder (MCD) Maintenance

M. E. Alberda

The Deep Space Network Progress Report 42-44
January and February 1978, pp 236-244,
April 15, 1978

This article describes the automated fault isolation test programs that have been developed to support rapid turn-around factory (or depot) level maintenance of the Maximum Likelihood Convolutional Decoder (MCD). Functional requirements and detailed design characteristics are described, along with a summary of the evaluation and testing completed so far.

ALCAZAR, F.

A013 S-Band Maser Phase Delay Stability Tests

J. M. Urech, F. Alcazar, J. Galvez, A. Rius, and
C. A. Greenhall

The Deep Space Network Progress Report 42-48
September and October 1978, pp 102-117,
December 15, 1978

For abstract, see Urech, J. M.

ALPER, M. E.

A014 Proceedings of the Alternate Energy Systems Seminar

M. E. Alper, R. E. Bartera, H. S. Davis,
R. G. Forney, C. F. Mohl, H. J. Stewart, and
V. C. Truscillo

JPL Publication 78-45, March 30, 1978

The Alternative Energy Systems Seminar was held on March 30, 1978 at the Jet Propulsion Laboratory. Sponsored jointly by the Southwest District Office of the U.S. Department of Energy and JPL, the seminar was an experiment in information exchange. The aim of the seminar was to present, in a single day, status and prospects for a number of advanced energy systems to a diverse, largely non-technical audience, and to solicit post-seminar responses from that audience as to the seminar's usefulness.

This article presents a lightly edited transcript of the talks given at the seminar, along with the visuals used by each speaker.

Prepared for the Department of Energy, Southwest District Office

ANANDA, M. P.

A015 An Improved Lunar Moment of Inertia Determination: A Proposed Strategy

M. P. Ananda, A. J. Ferrari, and W. L. Sjogren

Moon, Vol 17, pp 101-120, 1977

The current error of 0.0025 on the lunar homogeneity parameter I/MR^2 is dominated by the uncertainties in the C_{20} and C_{22} gravity harmonics. This error level is equivalent to a 4.20 gm cm^{-3} density uncertainty for a lunar interior model having a core 300 km in radius. Covariance analyses are performed using Doppler data from the relay satellite of the proposed Lunar Polar Orbiter mission to determine an optimum reduction strategy which obtains an order of magnitude improvement in the gravity estimates. Error studies show the long-arc reduction method obtains results which are an order of magnitude more accurate than the short-arc technique. The nominal 4000 km circular orbit of the relay satellite is very sensitive to the unmodeled effects of gravity harmonics of degree 5 through 9. Results from this orbital geometry indicate that it may not be possible to achieve the desired order of magnitude accuracy improvement. A modified orbit having the identical orbital conditions as the nominal one, but with a larger semi-major axis of 7000 km is studied. Results show the desired order of magnitude improvement can be achieved when a complete fourth degree and order model and some fifth and sixth degree terms are estimated while considering the unmodeled effects of the remaining harmonics through degree and order eight. Studies also show a 50% additional improvement in C_{22} can be achieved if differential differenced Doppler is also processed with the direct Doppler. The improved uncertainty in I/MR^2 reduces the core density error from 4.20 gm cm^{-3} to 0.1 gm cm^{-3} for the case of a lunar density model having a 300 km core radius.

ANDERSEN, R. W.

A016 Spacecraft Subsystem Checkout by Minicomputer

R. W. Andersen

Preprint, Minicomputer and Microcomputer Applications, Session 27, Midcon/77 Electron Show and Conv., Chicago, Ill., November 8-10, 1977

The minicomputer, with its large capacity in a small and inexpensive package, can be an important component in special-purpose test equipment. The Voyager spacecraft flight data subsystem support equipment is an example of computer-based test gear. The subsystem to be tested is a major control and data acquisition element of the Voyager spacecraft, with a large number of interfaces to several other onboard subsystems. This equipment was

designed to meet spacecraft subsystem testing requirements while making maximum use of off-the-shelf commercial components. Careful consideration was given to design tradeoffs in the areas of commercial versus specially built hardware and hardware versus software problem solutions. The resulting system is an integrated package of commercial and special-purpose hardware plus software.

ANDERSON, J. D.

A017 Tests of General Relativity Using Astrometric and Radio Metric Observations of the Planets

J. D. Anderson, M. S. W. Keese, E. L. Lau, E. M. Standish, Jr., and X. X. Newhall

Astronautica, Vol. 5, pp. 43-61, 1978

Current least squares fits to solar system data, including transit circle observations of the terrestrial and giant planets, radar observations of the terrestrial planets, Mariner 9 range fixes to Mars, and Pioneer 10/11 range fixes to Jupiter, have yielded some new results of interest to experimental relativity. Solutions have been obtained for the PPN parameters β and γ , the solar gravitational quadrupole moment J_2 , a time variation in the gravitational constant G , and four Nordtvedt parameters. The existing planetary data provide no significant result on the Nordtvedt effect. Under the assumption that the precession of the perihelion of Mercury is caused exclusively by planetary perturbations, general relativity, and the gravitational quadrupole moment, a value of $(2.5 \pm 1.6) \times 10^{-6}$ is obtained for J_2 . There are various combinations of the PPN parameters β , γ , α_1 , and α_3 that will also yield the observed precession of the perihelion, but there is no real empirical evidence for PPN values which disagree with general relativity. A positive upper bound of $1.4 \times 10^{-10} \text{ yr}^{-1}$ is indicated for \dot{G}/G from existing data. A few months of Viking data are needed to refine this result, and at least 2.5 yr of Viking data are needed to determine the Nordtvedt effect to the same accuracy as the current lunar laser result.

A018 Experimental Determination of Mercury's Mass and Oblateness

P. B. Esposito, J. D. Anderson, and A. T. Y. Ng

COSPAR Space Research, Vol. XVII, pp. 639-644, 1978

For abstract, see Esposito, P. B.

ANDERSON, J. L.

A019 Venus in Motion

J. L. Anderson, M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, N. Evans, and J. M. Soha

Astrophys. J. Suppl. Ser., Vol. 36, No. 2, pp. 275-284, February 1978

A comprehensive set of television pictures of Venus taken by the Mariner 10 spacecraft is presented. Included is a chronological sequence of television images illustrating the development, variety, and circulation of the Venus upper atmospheric phenomena as viewed in the near-ultraviolet. The higher resolution images have been assembled into global mosaics to facilitate comparison. Figures and tables describing the imaging sequences have been included to provide a guide to the more complete set of 3400 Venus images on file at the National Space Science Data Center.

ANDRESS, D. F.

A020 Final Report for Phase I—Coal Desulfurization by Low Temperature Chlorinolysis

J. J. Kalvinskas, G. C. Hsu, J. B. Ernest, D. F. Andress, and D. R. Feller

JPL Publication 78-8, November 23, 1977

For abstract, see Kalvinskas, J. J.

ARENS, W. E.

A021 Application of CCD Technology to Produce Imagery from Radar Data

W. E. Arens

J. Aircraft, Vol. 15, No. 1, pp. 21-27, January 1978

A real-time aircraft synthetic-aperture radar (SAR) image processor using charge-coupled device (CCD) technology has been developed. Both range and azimuth convolution are accomplished using CCD transversal filtering in the analog domain. The computational equivalency of a CCD transversal filter to comparatively more complex digital processing implementations provides significant reductions in processor power, weight, size, and cost requirements. This paper describes the results of the aircraft CCD SAR image-processor development work to date.

ASSEFI, T.

A022 Stochastic Processes, Estimation Theory, and Image Enhancement

T. Assefi

JPL Publication 78-50, June 1978

This book presents an introductory account of stochastic processes, estimation theory, and image enhancement. It is primarily intended for first-year graduate students and practicing engineers and scientists whose work requires an acquaintance with the theory. It reviews the fundamental concepts of probability that are required to support the main topics. The appendices discuss the remaining mathematical background.

ASTLE, L.

A023 Synthesis and Biological Screening of Novel Hybrid Fluorocarbon Hydrocarbon Compounds for Use as Artificial Blood Substitutes—Annual Report, July 1976–July 1977

J. Moacanin, K. Scherer, A. Toronto (Utah Biological Test Laboratory), D. Lawson, T. Terranova, L. Astle (Utah Biological Test Laboratory), and S. Harvey (Utah Biological Test Laboratory)

JPL Publication 77-80, January 15, 1978

For abstract, see Moacanin, J

ATKINS, K. L.

A024 Missions to Comets: An Options Review

K. L. Atkins

JPL Publication 78-55, July 1978

This review examines the available options for a first rendezvous mission to a comet. The starting point is provided by a number of past "opportunities surveys" that were updated and coalesced by Bender in 1974. The most promising opportunities developed by Bender are examined against several additional criteria, both programmatic and technical.

A025 The Ion Drive Program: Competition as the Key to Development Progress

K. L. Atkins

Preprint 78-716, AIAA/DGLR Thirteenth Int Electric Propulsion Conf., San Diego, Calif., April 25-27, 1978

During 1977, NASA seriously considered a rendezvous mission to Halley's Comet at its next return in 1986. This mission provided the catalyst for a larger arena where a struggle between Ion Drive and a Solar Sailing concept took place with the prize being selection as NASA's future high energy propulsion capability. The threat of extinction provided strong motivation for integrating emerging electric propulsion technology advances into

an innovative, high performance system concept. This paper chronicles the competition between Ion Drive and the Solar Sail describing the genesis of the competition, the strategy used by the Ion Drive Team, and the subsequent NASA assessment that led to the selection of Ion Drive as the preferred system to develop. The beneficial impact of NASA-wide attention on the competition resulted in increased awareness by decision makers of the significant capabilities of Ion Drive and a commitment to vigorously support the continued development.

AUMANN, H. H.

A026 Infrared Astronomical Satellite

H. H. Aumann and R. G. Walker (Ames Research Center)

Opt Eng, Vol 16, No 6, pp 537-543, November-December 1977

The objective of the Infrared Astronomical Satellite (IRAS) is to produce an unbiased all-sky survey in the wavelength region between 8 and 120 μm . Using a 60 cm diameter helium cooled telescope and detector arrays which are essentially zodiacal light background photon noise limited, heretofore unprecedented sensitivity can be achieved. The optical design, the focal plane layout and expected performance of the current design concept are discussed.

AVIZIENIS, A.

A027 A Study of Standard Building Blocks for the Design of Fault-Tolerant Distributed Computer Systems

D. A. Rennels, A. Avizienis (University of California, Los Angeles), and M. Ercegovac (University of California, Los Angeles)

Proc Eighth Annu Int Conf on Fault-Tolerant Computing, Toulouse, France, June 21-23, 1978, pp 144-149

For abstract, see Rennels, D. A.

BACK, L. H.

B001 Pressure Pulsations on a Flat Plate Normal to an Underexpanded Supersonic Jet

L. H. Back and V. Sarohia

AIAA J, Vol 16, No 6, pp 634-636, June 1978

An experiment was devised to study the interaction between an underexpanded supersonic gas jet and a flat plate, with the plate located in a region in which the interaction produces shock wave and flow fluctuations.

Nitrogen gas at ambient stagnation temperature flowed through a convergent nozzle with exit diameter of 2.03 cm and impinged on a square metal plate normal to the jet. Results revealed local peak pressure fluctuations on the plate at nozzle pressure ratios of about 2 and 4.5, with the latter case producing fluctuations of the same order as the mean pressure on the plate, the frequency of the oscillations was as large as 20 kHz. For choked jet flow at ambient pressure higher than atmospheric, the pressure fluctuation would increase accordingly, and adjacent solid structures would therefore be subjected to proportionately higher normal stresses.

B002 Analysis of Heat Losses and Casing Temperatures of Steam Injection Wells With Annular Coolant Water Flow

L. H. Back and R. F. Cuffel

Preprint SPE 7148, Calif Reg Meet SPE, San Francisco, Calif, April 12-14, 1978

Circulating coolant water from the ground level through the annulus between insulated steam tubing and the casing of injection wells was investigated analytically. Calculations indicated that the annular water flow decreased the percent energy loss to the surrounding rock and reduced casing temperatures. The analysis has application to oil recovery in deeper wells and for higher pressure and, thus, temperature steam.

BAISLEY, R. L.

B003 Automotive Fuel Economy and Emissions Program

M. W. Dowdy and R. L. Baisley

JPL Publication 78-21, June 1978

For abstract, see Dowdy, M. W.

BAKER, L. E.

B004 Analysis of DOT Near-Term Transportation Research, Development, and Demonstration Activities

L. E. Baker, D. W. Humphreys, and D. L. Vairin

JPL Publication 78-49, May 15, 1978

This document analyzes research, development, and demonstration activities to be conducted by the U.S. Department of Transportation within approximately the next five years.

Prepared for the U.S. Department of Transportation

BARATH, F. T.

B005 Future of Synthetic Aperture Radar

F. T. Barath

Proc Electron Aerospace Syst Conf (EASCON '78), Arlington, Virginia, September 24-27, 1978, pp 546-551

The present status of the applications of Synthetic Aperture Radars (SARs) is reviewed, and the technology state-of-the-art as represented by the Seasat-A and SIR-A SARs examined. The potential of SAR applications, and the near- and longer-term technology trends are assessed.

BARBIERI, R. H.

B006 Process Heat in California: Applications and Potential for Solar Energy in the Industrial, Agricultural and Commercial Sectors

R. H. Barbieri, R. E. Bartera, E. S. Davis, G. E. Hlavka, D. S. Pivrotto, and G. Yanow

JPL Publication 78-33, March 1978

A summary of the results of a survey of potential applications of solar energy for supplying process heat requirements in the industrial, agricultural and commercial sectors of California is presented. Technical, economic and institutional characteristics of the three sectors are examined. Specific applications for solar energy are then discussed. Finally, implications for California energy policy are discussed along with recommendations for possible actions by the State of California.

Prepared for the State of California Energy Resources Conservation and Development Commission

BARTERA, R. E.

B007 Solar Energy for Process Heat: Design/Cost Studies of Four Industrial Retrofit Applications

R. L. French and R. E. Bartera

JPL Publication 78-25, April 1, 1978

For abstract, see French, R. L.

B008 Process Heat in California: Applications and Potential for Solar Energy in the Industrial, Agricultural and Commercial Sectors

R. H. Barbieri, R. E. Bartera, E. S. Davis, G. E. Hlavka, D. S. Pivrotto, and G. Yanow

JPL Publication 78-33, March 1978

For abstract, see Barbieri, R. H.

B009 Proceedings of the Alternate Energy Systems Seminar

M. E. Alper, R. E. Bartera, H. S. Davis,
R. G. Forney, C. F. Mohl, H. J. Stewart, and
V. C. Truscello

JPL Publication 78-45, March 30, 1978

For abstract, see Alper, M. E.

BARTOS, K. P.

B010 The Goldstone Energy Project Final Report

K. P. Bartos

JPL Publication 78-5, February 15, 1978

The Goldstone Energy Project was established in 1974 to investigate ways in which the Goldstone Deep Space Communications Complex in California could be made partly or completely energy-sufficient, especially through the use of solar- and wind-derived energy resources. Ways in which energy could be conserved at the Complex were also studied. Findings include the following:

Wind energy (1) Theoretical developments are required to generate a simulation process that represents both wind distributions and correlations, point to point, and (2) Winds at Goldstone are insufficient in strength and duration to generate electric power economically.

Solar energy (1) Solar measurements should be correlated with meteorological data at the same site to identify which parameters are probabilistic and which are deterministic, (2) Circumsolar radiation measurements are required to determine the tracking accuracies required for the various types of concentrating collectors, (3) Solar collector technology has not developed to the point at which an energy-on-demand system can be built economically, (4) Heat transport piping costs dictate that solar collectors must be located near the point where heat energy is to be converted or used, and (5) Solar energy systems that produce energy-as-available show promise of becoming economically viable.

Energy storage. Hydrogen is not an economic energy storage medium because efficiencies are too low.

Energy Conservation (1) Improved computer programs are needed to analyze existing buildings to identify potential load reductions and evaluate proposed energy conservation measures and (2) Economic energy-conserving practices and progresses can be substituted for energy-intensive ones to save operating capital.

Obstacles to demonstrating energy self-sufficiency (1) Operation and maintenance costs of solar energy systems are estimated to be much higher than conventional energy systems, (2) Initial capital costs of present-day technology solar collectors are high and are compounded by low collector efficiency, and (3) No significant market force exists to create the necessary industry to reduce costs through mass production and broad open-market competition.

BATELAAN, P. D.

B011 Absolute Flux Density Calibrations of Radio Sources: 2.3 GHz

A. J. Freiley, P. D. Batelaan, and D. A. Bathker

Technical Memorandum 33-806, December 1, 1977

For abstract, see Freiley, A. J.

B012 DSN Water Vapor Radiometer Development—Recent Work, 1978

P. D. Batelaan and S. D. Slobin

The Deep Space Network Progress Report 42-48
September and October 1978, pp 129-135,
December 15, 1978

A water vapor radiometer (WVR) has been developed that measures the atmospheric noise temperature at two different frequencies near 22 GHz. These noise temperatures are used in empirical-theoretical equations that yield tropospheric range delay, in centimeters, through the atmosphere along the beam of the WVR. This range correction is then applied, as needed, to measurements concerning spacecraft range and to VLBI baseline determinations. This report discusses the WVR design and calibration techniques.

BATHKER, D. A.

B013 Absolute Flux Density Calibrations of Radio Sources: 2.3 GHz

A. J. Freiley, P. D. Batelaan, and D. A. Bathker

Technical Memorandum 33-806, December 1, 1977

For abstract, see Freiley, A. J.

BAUMERT, L. D.

B014 An Analysis of Alternate Symbol Inversion for Improved Symbol Synchronization in Convolutionally Coded Systems

L. D. Baumert, R. J. McEliece, and
H. van Tilborg (Technological University,
Netherlands)

The Deep Space Network Progress Report 42-44
January and February 1978, pp 90-97, April 15,
1978

In the current NASA Planetary Program Flight/Ground Data System Standard, it is proposed that alternate symbols of the output of a convolutional encoder be inverted in order to guarantee the symbol synchronizer a certain richness of symbol transition.

In this paper we analyze this technique, in particular we characterize those convolutional codes with the property that even if alternate symbols are inverted, arbitrarily long transition free symbol streams may occur. For codes which do not exhibit this pathological behavior, we give an upper bound on the largest possible transition-free run.

B015 A Probabilistic Version of Sperner's Theorem, With Applications to the Problem of Retrieving Information From a Data Base

L. D. Baumert, R. J. McEliece,
E. R. Rodemich, and H. Rumsey, Jr.

The Deep Space Network Progress Report 42-46
May and June 1978, pp 81-86, August 15, 1978

We show how the design of an optimal "merged key-code" information retrieval system involves finding the probability distribution on n -bit binary words that minimizes $P\{X \leq Y_1 \cup \dots \cup Y_r\}$ where X, Y_1, \dots, Y_r are selected independently according to the given probability distribution. We then find the minimizing probability distribution in the case $r = 1$.

B016 Soft Decision Decoding of Block Codes

L. D. Baumert and R. J. McEliece

The Deep Space Network Progress Report 42-47
July and August 1978, pp 60-64, October 15, 1978

The performance of certain block codes on a gaussian channel is evaluated. Two of these codes, the BCH codes of rates $1/2$ and $1/3$ length 128, are markedly superior to the constant length 7 rate $1/2$ convolutional code currently used for deep space missions. The algorithm used to derive these results provides a basis for a simple, almost optimum procedure for decoding these codes.

BEATTY, R. W.

B017 Analysis of Hydrogen Maser Frequency Drift Due to Possible Drifts in Load VSWR and Phase Angle of Reflection Coefficient

R. W. Beatty and T. Y. Otoshi

The Deep Space Network Progress Report 42-45
March and April 1978, pp 245-252, June 15, 1978

Theoretical equations are derived for calculating the effects of load VSWR and reflection coefficient phase-angle drifts on hydrogen maser frequency stability. Sample calculations made for a typical JPL maser show that under special load conditions, a VSWR drift of $7.5 \times 10^{-5}/h$ or phase angle drift of $0.015 \text{ deg}/h$ can produce a

frequency drift of $(10^{-14}f_0) \text{ Hz}/h$ where f_0 is the maser frequency of approximately $1.42 \times 10^9 \text{ Hz}$.

BEDNARCZYK, S.

B018 Preliminary Studies of Electromagnetic Sounding of Cometary Nuclei

A. Gabriel, L. Warne, S. Bednarczyk, and
C. Elachi

JPL Publication 78-44, October 1, 1978

For abstract, see Gabriel, A.

BEER, R.

B019 The D/H and C/H Ratios in Jupiter From the CH_3D Phase

R. Beer and F. W. Taylor

Astrophys J, Vol 219, No 2, Part 1, pp 763-767, January 15, 1978

Previous determinations of the D/H ratio in Jupiter have given inconsistent results. From the CH_3D abundance, a ratio $\text{D}/\text{H} = 4.8 \pm 2.5 \times 10^{-5}$ was found by Beer and Taylor in 1973, whereas a ratio of $2.1 \pm 0.4 \times 10^{-5}$ was found in the same year by Trauger *et al* from the HD phase. A recent reevaluation of the HD result by McKellar *et al* increases the ratio to $5.6 \pm 1.4 \times 10^{-5}$, in apparent agreement with Beer and Taylor's results.

New, higher resolution observations of CH_3D in Jupiter suggest that (a) the apparent CH_3D column abundance is variable, (b) the agreement between McKellar *et al* and Beer and Taylor is fortuitous, and (c) both the ratios D/H and C/H are greater than the "cosmic" values by substantial factors.

BELTON, M. J. S.

B020 Venus in Motion

J. L. Anderson, M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson,
N. Evans, and J. M. Soha

Astrophys J Suppl Ser, Vol 36, No 2, pp 275-284, February 1978

For abstract, see Anderson, J. L.

BENJAUTHRIT, B.

B021 Transform Decoding of Reed-Solomon Codes Over $\text{GF}(2^{2^n})$ Using the Techniques of Winograd

I. S. Reed (University of Southern California),
T. K. Truong, and B. Benjauthrit

The Deep Space Network Progress Report 42-43
November and December 1977, pp 141-163,
February 15, 1978

For abstract, see Reed, I S

- B022 On Decoding of Reed-Solomon Codes Over $GF(32)$ and $GF(64)$ Using the Transform Techniques of Winograd**

I S. Reed (University of Southern California),
T. K. Truong, and B Benjauthrit

The Deep Space Network Progress Report 42-44
January and February 1978, pp. 139-171,
April 15, 1978

For abstract, see Reed, I S

- B023 A Brief Historical Introduction to Very Long Baseline Interferometry**

B. Benjauthrit

The Deep Space Network Progress Report 42-46
May and June 1978, pp 146-153, August 15,
1978

This article provides a short historical account of Very Long Baseline Interferometry, including the rationale, development, and experiments

- B024 An Extensive Bibliography on Long Baseline Interferometry**

B. Benjauthrit

The Deep Space Network Progress Report 42-46
May and June 1978, pp 154-181, August 15,
1978

This article presents an extensive bibliography on the subject of long baseline interferometry, starting from the time of Albert A Michelson (1890) up to the present time. It contains over 400 references, including areas of long baseline interferometry applications

- B025 On the Fundamental Structure of Galois Switching Functions**

B. Benjauthrit and I. S. Reed

IEEE Trans Computers, Vol C-27, No 8,
pp 757-762, August 1978

It is shown in this paper that the fundamental structure of Galois switching functions follows naturally from that of Boolean switching functions. An expanded formula for deriving multinomial Galois switching functions is provided with illustrations of its application

BENTON, W. D.

- B026 IPL Processing of the Viking Orbiter Images of Mars**

R. M. Ruiz, D. A. Elliott, G. M. Yagi,
R B. Pomphrey, M. A. Power, K. W. Farrell, Jr.,
J. J. Lorre, W. D. Benton, R. E. Dewar, and
L. E. Cullen

J Geophys Res, Vol 82, No 28, pp 4189-4202,
September 30, 1977

For abstract, see Ruiz, R. M

BERDAHL, C. M.

- B027 Calibration Standards and Field Instruments for the Precision Measurement of Insolation**

M. S. Reid, C. M. Berdahl, and
J. M. Kendall, Sr.

Solar Energy, Vol 20, pp 357-358, 1978

For abstract, see Reid, M S

BERGSTRALH, J. T.

- B028 Sodium D-Line Emission From Io: Comparison of Observed and Theoretical Line Profiles**

R. W. Carlson, D. L. Matson, T. V. Johnson, and
J. T. Bergstralh

Astrophys J, Vol 223, pp 1082-1086, August 1,
1978

For abstract, see Carlson, R. W

- B029 Intensity and Pressure Shift of the H_2 (4,0) $S(1)$ Quadrupole Line**

J. T. Bergstralh, J. S. Margolis, and
J. W. Brault (Kitt Peak National Observatory)

Astrophys J, Vol 224, pp L39-L41, August 15,
1978

We report two laboratory measurements, made at two different pressures, of the intensity and central frequency of the (4,0) $S(1)$ line of H_2 . The measured intensity is significantly lower than that predicted from theoretical matrix elements for the transition. However, the pressure shift predicted by McKellar appears to be verified within the precision of our measurement

BERGSTROM, S. L.

- B030 Thermal Resistance of Naturally Occurring Airborne Bacterial Spores**

J. R. Puleo, S. L. Bergstrom, J. T. Peeler (Food and Drug Administration, Cincinnati, Ohio), and G. S. Oxborrow, (Food and Drug Administration, Minneapolis, Minnesota)

Appl Environ Microbiol, Vol 36, No 3, pp 473-479, September 1978

For abstract, see Puleo, J. R.

BERLEKAMP, E. R.

B031 On the Inherent Intractability of Certain Coding Problems

E. R. Berlekamp (University of California, Berkeley), R. J. McEliece, and H. C. A. van Tilborg (Technological University of Eindhoven, Netherlands)

IEEE Trans Inform Theor, Vol IT-24, No 3, pp 384-386, May 1978

The fact that the general decoding problem for linear codes and the general problem of finding the weights of a linear code are both NP-complete is shown. This strongly suggests, but does not rigorously imply, that no algorithm for either of these problems which runs in polynomial time exists.

BERMAN, A. L.

B032 Deep Space Telecommunications and the Solar Cycle: A Reappraisal

A. L. Berman

The Deep Space Network Progress Report 42-43
November and December 1977, pp 110-124,
February 15, 1978

Observations of density enhancement in the near corona at solar cycle (sunspot) maximum have rather uncritically been interpreted to apply equally well to the extended corona, thus generating concern about the quality of outer planet navigational data at solar cycle maximum. Spacecraft have been deployed almost continuously during the recently completed solar cycle 20, providing two powerful new coronal investigatory data sources: (1) in-situ spacecraft plasma measurements at approximately 1 AU, and (2) plasma effects on monochromatic spacecraft signals at all signal closest approach points.

A comprehensive review of these (solar cycle 20) data leads to the somewhat surprising conclusion that for the region of interest of navigational data, the highest levels of charged-particle corruption of navigational data can be expected to occur at solar cycle minimum, rather than solar cycle maximum, as previously believed.

B033 Ground Tracking System Phase Fluctuation Spectra

A. L. Berman

The Deep Space Network Progress Report 42-43
November and December 1977, pp 125-128,
February 15, 1978

Spectral analysis of solar wind plasma fluctuation requires knowledge of the average ground tracking system phase fluctuation spectrum. This article presents typical ground tracking system phase fluctuation spectra as deduced from two-way S-band doppler noise measured at large Sun-Earth-Probe angles.

B034 System Performance Testing of the DSN Radio Science System, Mark III-78

A. L. Berman and J. S. Mehta

The Deep Space Network Progress Report 42-43
November and December 1977, pp 129-133,
February 15, 1978

System Performance Tests are required to evaluate system performance following initial system implementation and subsequent modification, and to validate system performance prior to actual operational usage. This article describes non-real-time end-to-end Radio Science system performance tests that are based on the comparison of open-loop radio science data to equivalent closed-loop radio metric data, as well as an abbreviated Radio Science real-time system performance test that validates critical Radio Science System elements at the Deep Space Station prior to actual operational usage.

B035 Electron Density and Doppler RMS Phase Fluctuation in the Inner Corona

A. L. Berman

The Deep Space Network Progress Report 42-44
January and February 1978, pp 172-179,
April 15, 1978

Previous work has developed a self-consistent set of solar wind descriptors for the extended corona. In this article, observations of the radial dependence of electron density and RMS phase fluctuation are used to construct a similar and symmetrical set of descriptors for the vastly different regime of the inner corona. The article concludes that the applicability of symmetrical coronal descriptors for both the inner and extended corona argues forcefully for the basic validity of the description.

B036 The DSS Radio Science Subsystem—Real-Time Bandwidth Reduction and Wideband Recording of Radio Science Data

A. L. Berman

The Deep Space Network Progress Report 42-44
January and February 1978, pp 180-188,
April 15, 1978

New radio science experiment requirements levied by the Pioneer Venus Project have resulted in the development of a multimission radio science subsystem at the 64-m subnet. Major functional capabilities of the DSS Radio Science Subsystem (DRS) are real-time bandwidth reduction and wideband recording of radio science data. This article provides a functional description of the key characteristics, requirements, and operation of the DRS.

B037 Solar Wind Density Fluctuation and the Experiment to Detect Gravitational Waves in Ultraprecise Doppler Data

A. L. Berman

The Deep Space Network Progress Report 42-44
January and February 1978, pp 189-196,
April 15, 1978

The experiment to detect gravitational waves in ultraprecise Doppler data requires a total system (DSN Tracking System, spacecraft transponder and media) fractional frequency fluctuation of approximately 1×10^{-15} for averaging times greater than 1000 seconds. At such levels, solar wind density fluctuation looms as a very difficult error source.

This article presents a detailed examination of solar wind electron (columnar) density fluctuation as it applies to the experiment to detect gravitational waves in ultraprecise doppler data. Expected two-way S-band fractional frequency fluctuation (due to solar wind density fluctuation) at a 1000-second averaging time is considered to be approximately 3×10^{-13} , while the optimum two-way X-band (X-band uplink and downlink) performance is predicted to be (also at a 1000-second averaging time) approximately 1×10^{-14} . The article concludes that both two-way S-band and X-band will be required (simultaneously) so that the predicted two-way X-band performance ($\sim 10^{-14}$) can be improved to a (defined) media goal of 3×10^{-16} via two-way dual frequency calibration of solar wind induced density fluctuation.

B038 Solar Wind Turbulence Models Evaluated via Observations of Doppler RMS Phase Fluctuation and Spectral Broadening in the Inner Corona

A. L. Berman

The Deep Space Network Progress Report 42-44
January and February 1978, pp 197-202,
April 15, 1978

The modelling of doppler noise (RMS phase fluctuation) has enjoyed considerable success via the experimentally observed proportionality between doppler noise and integrated electron density. Recently, theoretically derived

models for doppler noise have been proposed. These models are broadly characterized as representing proportionality between doppler RMS phase fluctuation (ϕ) and particle flux. Under the assumptions of conservation of particle flux in the solar wind and proportionality between electron density and electron density fluctuation, these models yield a doppler noise dependence upon signal closest approach point (a) of $\phi \propto a^{-1.5}$.

Doppler noise observations in the inner corona are shown to conclusively demonstrate that doppler noise is proportional to integrated electron density ($\sim a^{-5}$), and not $a^{-1.5}$, as predicted by the particle flux models. Similarly, spectral broadening in the inner corona is seen to be proportional to integrated density. The article concludes that the particle flux models are in disagreement with the experimental observations of doppler noise to date, and hence are unlikely to be representative of actual solar wind processes.

B039 The Gravitational Wave Detection Experiment: Description and Anticipated Requirements

A. L. Berman

The Deep Space Network Progress Report 42-46
May and June 1978, pp 100-108, August 15,
1978

One of the most exciting challenges facing gravitational theoreticians and experimenters in the remaining decades of this century will be the search for "gravitational waves" as predicted by Einstein's General Theory of Relativity. Proposals have been advanced to search for gravitational waves in ultraprecise two-way Doppler data. In such an experiment, the total measurement system includes the Deep Space Network Tracking System, the spacecraft, the intervening media, and the data processing system. Preliminary estimates of gravitational wave characteristics are used to define a baseline experiment, with a total measurement system fractional frequency fluctuation of 1×10^{-15} , and a desirable experiment, with a total measurement system fractional frequency fluctuation of 1×10^{-17} .

The experiment to detect gravitational waves in ultraprecise two-way Doppler data is described, as are the anticipated requirements for the Deep Space Network, the spacecraft, and the data processing system. The article concludes by describing the steps necessary to provide the capability to perform this experiment.

B040 The DSS Radio Science Subsystem—Data Handling of Very Long Baseline Interferometry (VLBI) Data

A. L. Berman

The Deep Space Network Progress Report 42-46
May and June 1978, pp 115-122, August 15,
1978

The DSS Radio Science Subsystem, originally implemented to provide the data handling capabilities for the DSN Radio Science System, will be modified and augmented to provide similar capabilities for the newly created DSN Very Long Baseline Interferometry (VLBI) System. This article describes the key characteristics, functional requirements, and operation of the DSS Radio Science Subsystem (DRS) as they pertain to usage of the DRS by the DSN VLBI System.

B041 DSN Radio Science System, Mark III-78

A. L. Berman

The Deep Space Network Progress Report 42-47
July and August 1978, pp 4-14, October 15, 1978

The DSN Radio Science System was created in February 1977, following a successful review of radio science requirements. This article describes the DSN Radio Science System, Mark III-78, as it has evolved in the eighteen months following its inception. Included in the article are the system definition, key characteristics, functional description, and functions of the Deep Space Stations, Ground Communications Facility, Network Operations Control Center, and Network.

Implementation of the "real-time bandwidth reduction," "wideband recording," and "non-real-time bandwidth reduction" capabilities in support of Pioneer Venus Orbiter, Voyager (Jupiter Encounter), and Pioneer Venus Multiprobe is nearing completion. Implementation of the "medium bandwidth recording" capability in support of Voyager (Saturn Ring Experiment) is under way, and is scheduled for completion in May of 1979.

B042 Radio Science Requirements and the End-to-End Ranging System

A. L. Berman

The Deep Space Network Progress Report 42-47
July and August 1978, pp 65-71, October 15, 1978

Radio science ranging requirements negotiated between past and present flight projects and the DSN have generally focused on just the DSS and spacecraft hardware. All elements in the end-to-end ranging system must be analyzed and considered in terms of an error hierarchy before reasonable and cost-effective requirements can be levied upon any individual element. This article defines and examines the end-to-end ranging system as it applies to the generation of radio science ranging requirements. Particularly emphasized is the variability of the performance levels of certain of the system elements with respect

to the type of radio science experiment being performed and the DSN-spacecraft frequency band configuration.

B043 Parametric Modeling of Low-Frequency Water-Vapor-Induced Tropospheric Path Length Fluctuations

A. L. Berman

The Deep Space Network Progress Report 42-47
July and August 1978, pp 72-76, October 15, 1978

Detailed wet tropospheric fluctuation information will be required to support proposals to search for gravitational waves in ultra-precise Doppler data. In this article, similarities between the solar wind and tropospheric effects on apparent signal path length ("signal delay") are used to hypothesize a parametric model for low-frequency wet tropospheric path length fluctuations. Recent experimental observations of wet tropospheric signal delay fluctuations can be interpreted as confirming this parametric form. The model is used to suggest the appropriate conditions for collection of experimental tropospheric fluctuation data.

B044 Simultaneous Dual-Frequency, Round-Trip Calibration of Doppler Data With Application to Radio Science Experiments

A. L. Berman

The Deep Space Network Progress Report 42-48
September and October 1978, pp 48-54,
December 15, 1978

Simultaneous dual-frequency, round-trip (uplink and downlink) calibration of Doppler data is expected to be a requirement of several radio science experiments being planned for the next decade, and such (calibration) capability is expected to be achieved by the mid-1980s. Simultaneous dual-frequency, round-trip calibration would be straightforward except for the condition of unequal spacecraft turnaround ratios at S- and X-band. This article discusses the impact of unequal turnaround ratios on calibration accuracies in the specific cases of the Gravitational Wave Detection Experiment and the Solar Gravitational Quadrupole Moment Experiment.

B045 A Solar Wind Turbulence Event During the Voyager 1978 Solar Conjunction Profiled via a New DSN Radio Science Data Capability

A. L. Berman and A. D. Contreas

The Deep Space Network Progress Report 42-48
September and October 1978, pp 55-58,
December 15, 1978

The Deep Space Network (DSN) has implemented a new radio science data capability within the DSN Tracking System—routine provision of phase fluctuation data con-

currently computed over several different time scales. This new capability has been used to observe phase fluctuation spectral characteristics during a rapid increase in solar wind turbulence that occurred during a July 23, 1978, track of the Voyager 1 spacecraft by Deep Space Station (DSS) 11. This article suggests that the new capability will prove quite useful in future studies of variations in Solar Wind phase fluctuation spectral characteristics with, for instance, parameters such as the solar (sunspot) cycle and radial distance.

B046 Radial and Solar Cycle Variations in the Solar Wind Phase Fluctuation Spectral Index as Determined From Voyager 1978 Solar Conjunction Data

A. L. Berman and A. D. Contreas

The Deep Space Network Progress Report 42-48
September and October 1978, pp 59-65,
December 15, 1978

Of current interest is the value of and possible variations in the solar wind phase fluctuation spectral index. This article presents columnar spectral index information that has been extracted from a sizable volume of Voyager 1978 solar conjunction doppler phase fluctuation data. The Voyager 1978 results, when compared to similar information derived from the 1976 Helios and Viking Solar Conjunctions, lead to the following inferences: (1) there has been a significant change in the spectral index from 1976 to 1978, (2) there is continuing evidence that favors a slight (positive) correlation between the spectral index and the solar (sunspot) cycle, (3) there is little or no evidence in support of a radial variation of the spectral index.

BEVAN, J

B047 A Survey of Electric and Hybrid Vehicle Simulation Programs: Final Report

J. Bevan, D. A. Heimbürger, and M. A. Metcalfe

JPL Publication 78-58, Vol 1, July 1, 1978

This report summarizes the results of a survey conducted within the United States to determine the extent of development and capabilities of automotive performance simulation programs suitable for electric and hybrid vehicle studies. The survey was conducted for the Department of Energy by NASA's Jet Propulsion Laboratory in support of Public Law 94-413, the Electric and Hybrid Vehicle Research, Development and Demonstration Act of 1976.

BHANJI, A. M.

B048 Long-Duration High-Efficiency Operation of a Continuously Pulsed Copper Laser Utilizing Copper Bromide as a Lasant

C. J. Chen, A. M. Bhanji, and G. R. Russell

Appl Phys Lett, Vol 33, No 2, pp 146-148,
July 15, 1978

For abstract, see Chen, C J

B049 A Continuously Pulsed Copper Halide Laser with a Cable-Capacitor Blumlein Discharge Circuit

N. M. Nerhiem, A. M. Bhanji, and G. R. Russell

IEEE J Quantum Electron, Vol. QE-14, No. 9, pp 686-693, September 1978

For abstract, see Nerhiem, N M

BIERMAN, G. J.

B050 A Parameter Estimation Subroutine Package

G. J. Bierman and M. W. Nead

JPL Publication 77-26, Rev 2, October 15, 1978

Linear least squares estimation and regression analyses continue to play a major role in orbit determination and related areas. In this report we document a library of FORTRAN subroutines that have been developed to facilitate analyses of a variety of estimation problems. Our purpose is to present an easy to use, multi-purpose set of algorithms that are reasonably efficient and which use a minimal amount of computer storage. Subroutine inputs, outputs, usage and listings are given, along with examples of how these routines can be used. The following outline indicates the scope of this report: Section I, introduction with reference to background material, Section II, examples and applications, Section III, a subroutine directory summary, Section IV, the subroutine directory user description with input, output and usage explained, and Section V, subroutine FORTRAN listings. The routines are compact and efficient and are far superior to the normal equation and Kalman filter data processing algorithms that are often used for least squares analyses.

B051 An Application of the Square Root Information Filter to Large-Scale Linear Interconnected Systems

G. J. Bierman

IEEE Trans Automat Contr, Vol AC-22, No 6,
pp 989-991, December 1977

In this paper it is demonstrated that application of the square root information filter can dramatically reduce the

storage and computation involved with estimation of certain classes of large-scale interconnected systems

B052 Application of Kalman Filtering to Spacecraft Range Residual Prediction

G. A. Madrid and G. J. Bierman

IEEE Trans Automat Contr, Vol AC-23, No 3, pp 430-433, June 1978

For abstract, see Madrid, G. A.

B053 Applications of Modern Estimation Techniques to Aircraft Navigation

G. J. Bierman

Proc IEEE Conf Decision and Control, New Orleans, La., Dec 7-9, 1977, Vol 1, pp 303-308

Our purpose in this paper is to highlight a few of the techniques and ideas that have found great utility in the design and analysis of Kalman filters. We focus attention on little discussed pragmatic aspects of filter design and details of computer implementation which are crucial for successful aircraft applications.

BILLS, B. G.

B054 Mars Topography Harmonics and Geophysical Implications

B. G. Bills (California Institute of Technology) and A. J. Ferrari

J Geophys Res, Vol 83, No B7, pp 3497-3508, July 10, 1978

An improved model of Martian global topography has been obtained by fitting a sixteenth-degree harmonic series to occultation, radar, spectral, and photogrammetric measurements. The existing observations have been supplemented in areas without data by empirical elevation estimates based on photographic data. The mean radius is 3389.92 ± 0.04 km. The corresponding mean density is 3.9331 ± 0.0018 g cm⁻³. The center of figure is displaced from the center of mass by 2.50 ± 0.07 km toward $62^\circ \pm 3^\circ$ S, $272^\circ \pm 3^\circ$ W. The geometric flattening ($f_g = (6.12 \pm 0.04) \times 10^{-3}$) is too great and the dynamic flattening ($f_d = (5.22 \pm 0.03) \times 10^{-3}$) is too small for Mars to be homogeneous and hydrostatic. It is confirmed that the low-degree gravity harmonics are produced primarily by surface height variations and only secondarily by lateral density variations. Maps of the data distribution, global topography, and Bouguer gravity anomaly are presented. These are interpreted in terms of a crustal thickness map which is consistent with gravity, topography, and recent preliminary Viking seismic results. From plausible density contrasts and an assumed

zero crustal thickness at Hellas, the inferred minimum mean crustal thickness is 28 ± 4 km.

BORDEN, C. S.

B055 A Life-Cycle Description of Underground Coal Mining

M. L. Lavin, C. S. Borden, and J. R. Duda

JPL Publication 78-26, April 1978

For abstract, see Lavin, M. L.

BORN, G. H.

B056 The Mass of Phobos From Viking Flybys

E. J. Christensen, G. H. Born, C. E. Hildebrand, and B. G. Williams

Geophys Res Lett, Vol 4, No 12, pp 555-557, December 1977

For abstract, see Christensen, E. J.

BOUCK, A. C.

B057 Pioneer Venus Mission Support

A. C. Bouck

The Deep Space Network Progress Report 42-48, September and October 1978, pp 12-14, December 15, 1978

This article reports on activities within the Deep Space Network (DSN) to prepare for the Pioneer Venus Multiprobe Venusian Encounter.

BOWYER, J. M., JR

B058 An Investigation of the Side Force that is Sometimes Observed in Rocket Start-Up

J. M. Bowyer, Jr., G. W. Kreiter (Vought Corporation), and R. E. Peterson (University of Arizona)

Preprint 78-1045, AIAA/SAE Fourteenth Joint Propulsion Conf., Las Vegas, Nevada, July 25-27, 1978

The occurrence of a large but momentary side force during the start-up of rocket motors employing convergent-divergent nozzles has been noted occasionally. Asymmetric flow separation within the divergent section of the nozzle is proposed as the principal source of this lateral force.

A method for estimating this force and its concomitant lateral impulse is outlined, and results obtained by applying the method to Scout vehicle first-, second-, and third-stage rocket motor start-ups are presented and compared with similar estimates that other researchers obtained by a different method

BRANDHORST, H.

B059 High-Power, Ultralow-Mass Solar Arrays: FY-77 Solar Arrays Technology Readiness Assessment Report

E. N. Costogue, L. E. Young (Marshall Space Flight Center), and H. Brandhorst (Lewis Research Center)

JPL Publication 78-48, Vol. I, June 15, 1978

For abstract, see Costogue, E. N.

B060 High-Power, Ultralow-Mass Solar Arrays: FY-77 Solar Arrays Technology Readiness Assessment Report

E. N. Costogue, L. E. Young (Marshall Space Flight Center), and H. Brandhorst (Lewis Research Center)

JPL Publication 78-48, Vol. II, June 15, 1978

For abstract, see Costogue, E. N.

BRAULT, J. W.

B061 Intensity and Pressure Shift of the H_2 (4,0) S(1) Quadrupole Line

J. T. Bergstralh, J. S. Margolis, and J. W. Brault (Kitt Peak National Observatory)

Astrophys J., Vol. 224, pp. L39-L41, August 15, 1978

For abstract, see Bergstralh, J. T.

BRECKINRIDGE, J. B.

B062 A White-Light Amplitude Interferometer With 180-Degree Rotational Shear

J. B. Breckinridge

Opt. Eng., Vol. 17, No. 2, pp. 156-159, March-April 1978

The fabrication and assembly of a point symmetric, rotational shear interferometer with 180-degree rotation is given. It has been used to photograph the Michelson Stellar interferometer fringes in white light without the

use of an image intensifier at a large astronomical telescope

BRENKLE, J.

B063 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography: Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle, E. Christensen, D. Farless, J. Mehta, B. Seidel, W. Michael, Jr. (Langley Research Center), A. Wallio (Langley Research Center), and M. Grossi (Raytheon Company)

J. Geophys. Res., Vol. 82, No. 28, pp. 4317-4324, September 30, 1977

For abstract, see Fjeldbo, G.

BROCKMAN, M. H.

B064 Radio-Frequency Carrier Arraying for High-Rate Telemetry Reception

M. H. Brockman

The Deep Space Network Progress Report 42-45 March and April 1978, pp. 209-223, June 15, 1978

A method for increasing the sensitivity for radio-frequency reception is to array receiving systems or stations in such a manner as to provide signal-to-noise ratio improvement relative to a single receiving system or station. Radio-frequency carrier arraying for high-rate telemetry that provides signal-to-noise ratio improvement for RF carrier reception and demodulation represents one element of such an array.

BROWN, D. S.

B065 Δ VLBI Spacecraft Tracking System Demonstration. Part I. Design and Planning

D. L. Brunn, R. A. Preston, S. C. Wu, H. L. Siegel, D. S. Brown, C. S. Christensen, and D. E. Hilt

The Deep Space Network Progress Report 42-45 March and April 1978, pp. 111-132, June 15, 1978

For abstract, see Brunn, D. L.

BRUNN, D. L.

B066 Δ VLBI Spacecraft Tracking System Demonstration. Part I. Design and Planning

D L Brunn, R A Preston, S C Wu,
H L Siegel, D S Brown C S Christensen, and
D E Hilt

The Deep Space Network Progress Report 42-45
March and April 1978, pp 111-132, June 15,
1978

The current status of planned Δ VLBI Navigation demonstrations during Voyager Jupiter encounters is discussed. Error analysis indicates angular accuracies of $0.05 \mu\text{rad}$ are possible. Near real-time data transmission can be achieved with minimal station hardware and software modifications. A software correlator and phase tracking program, operating on the SFOF IBM 360, will be used for data processing. Data quality tests will begin on July 1978 and formal demonstrations will start on January 1979.

BRUNSTEIN, S. A.

B067 A Transform-Pair Relationship Between Incident and Scattered Fields from an Arbitrary Reflector

A. C. Ludwig (Technical University of Denmark, Lyngby, Denmark) and S. A. Brunstein

Radio Sci., Vol 13, No 5, pp 785-788,
September-October 1978

For abstract, see Ludwig, A. C.

BRYAN, A. I.

B068 Pioneer Venus 1978 Deep Space Network Telecommunications Compatibility Test Program Status

A. I. Bryan and R. P. Kemp

The Deep Space Network Progress Report 42-45
March and April 1978, pp 39-100, June 15, 1978

The Pioneer Venus 1978 Flight Project DSN Telecommunications Compatibility Test Program consists of three phases: Subsystem Design, System Design and System Verification Tests, which are to be performed at JPL and at the U.S. Air Force Eastern Test Range and Kennedy Space Center Complexes. Subsystem Design Tests were performed during April 1977. A subset of System Design Tests were performed during November 1977. This article describes the tests that have been completed through 1977.

BRYAN, L.

B069 Synthetic Aperture Radar Imagery of the AIDJEX Triangle

L. Bryan, T. Farr, F. Leberl, and C. Elachi

AIDJEX Bull., No 37, pp 161-187,
September 1977

Imaging radar mosaics of the AIDJEX triangle are presented together with a brief discussion of the radar sensor used in the data collection.

BRYAN, M. L.

B070 Computer Processing of SAR L-Band Imagery

M. L. Bryan, W. D. Stromberg, and T. G. Farr

Photogram Eng. Remote Sensing, Vol 43, No 10,
pp 1283-1294, October 1977

A continuing problem with the interpretation of synthetic aperture radar (SAR) data, especially in the image format, is the fact that such radar systems generally are not calibrated. This tends to reduce the validity of computer processing in the form of automatic interpretation as it may be applied to SAR imagery. However, for some classes of targets, i.e., those which have especially constant and high or low returns, such automatic discrimination can be attained easily and quickly by digitally filtering and thresholding the data. We have applied such procedures to two scenes, one of sea ice and the other of fresh-water lakes. The orientation of leads (through a Fourier transform) together with the percentage of open water in the entire sea ice scene is quickly attained. For the lake scene the areas of lakes were determined with a high accuracy by using the standard library routines in a General Electric Image 100 system. These techniques demonstrate the validity of machine processing for obtaining quantitative data for some classes of targets as seen by uncalibrated synthetic aperture radars.

BRYANT, N. A.

B071 Elements of an Image-Based Information System

A. J. Zobrist and N. A. Bryant

Policy Anal. Inform. Syst., Knowledge Systems
Laboratory, University of Illinois at Chicago,
pp 71-90, 1978

For abstract, see Zobrist, A. J.

BUCHANAN, P.

B072 Effect of Ultrasonic Irradiation of Mammalian Cells and Chromosomes *in vitro*

J. A. Roseboro, P. Buchanan (University of North Carolina, Chapel Hill), A. Norman (University of California, Los Angeles), and R. Stern (University of California, Los Angeles)

Phys Med Biol, Vol 23, No 2, pp 324-331, 1978

For abstract, see Roseboro, J. A.

BURKE, A.

B073 Automotive Technology Status and Projections: Executive Summary

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol I, June 1978

For abstract, see Dowdy, M

B074 Automotive Technology Status and Projections: Assessment Report

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol II, June 1978

For abstract, see Dowdy, M

BURUM, D. P.

B075 Calculation of Spin-Lattice Relaxation During Pulsed Spin Locking in Solids

W. K. Rhim, D. P. Burum (California Institute of Technology), and D. D. Elleman

J Chem Phys, Vol 68, No 2, pp 692-695, January 1978

For abstract, see Rhim, W. K.

B076 A Multiple Pulse Zero Crossing NMR Technique, and Its Application to ^{19}F Chemical Shift Measurements in Solids

D. P. Burum (California Institute of Technology), D. D. Elleman, and W. K. Rhim

J Chem Phys, Vol 68, No 3, pp 1164-1169, February 1978

A simple, multiple pulse "zero crossing technique" for accurately determining the first moment of a solid state NMR spectrum is introduced. This technique was applied to obtain the ^{19}F chemical shift versus pressure curves up to 5kbar for single crystals of CaF_2 (0.29 ± 0.02 ppm/kbar) and BaF_2 (0.62 ± 0.05 ppm/kbar). Results at ambient temperature and pressure are also reported for a number of other fluorine compounds. Because of its high data rate, this technique is potentially several orders of magnitude more sensitive than similar cw methods.

B077 New Technique for Single-Scan T_1 Measurements Using Solid Echoes

D. P. Burum, D. D. Elleman, and W. K. Rhim

Rev Sci Instrum, Vol 49, No 8, pp 1169-1175, August 1978

A simple technique for single-scan T_1 measurements in solids is proposed and analyzed for single exponential spin-lattice relaxation. In this technique, the direct spin heating caused by the sampling process is significantly reduced in comparison with conventional techniques by utilizing the "solid echo" to refocus the magnetization. The applicability of this technique to both the solid and liquid phase is demonstrated.

BUTMAN, S. A.

B078 Bandwidth Compression of Synthetic Aperture Radar Imagery by Quantization of Raw Radar Data

R. G. Lipes and S. A. Butman

Proc SPIE, Vol 119, pp 107-114, 1977

For abstract, see Lipes, R. G.

CALLAHAN, P. S.

C001 An Analysis of Viking S-X Doppler Measurements of Solar Wind Columnar Content Fluctuations

P. S. Callahan

The Deep Space Network Progress Report 42-44 January and February 1978, pp 75-81, April 15, 1978

More than 320 passes of Viking S-X Doppler data have been used to investigate columnar content fluctuations in the solar wind from 19 August, 1976 to 28 February, 1977. These data are used to estimate the power spectrum and radial dependence of solar wind density fluctuations. It is found that (1) the electron density fluctuations decline with heliocentric distance as $r^{-1.8 \pm 0.1}$, (2) the power spectrum depends on fluctuation frequency as $\nu^{-2.5 \pm 0.2}$. These results are used to predict range change as a function of time scale and sun-earth-probe angle. Changes of interest for advanced navigation techniques are found to be likely.

CANNON, W. A.

C002 Mars' Regolith Adsorption and the Relative Concentrations of Atmospheric Rare Gases

F. P. Fanale, W. A. Cannon, and T. Owen (State University of New York, Stony Brook)

Geophys Res Lett, Vol 5, No 1, pp 77-80,
January 1978

For abstract, see Fanale, F P

- C003 Mars: The Role of the Regolith in Determining Atmospheric Pressure and the Atmosphere's Response to Insolation Changes**

F. P. Fanale and W. A. Cannon

J Geophys Res, Vol 83, No B5, pp 2321-2325,
May 10, 1978

For abstract, see Fanale, F P

CARL, C.

- C004 Wide Area Detection System: Conceptual Design Study**

E. E. Hilbert, C. Carl, W. Goss, G. R. Hansen,
M. J. Olsasky, and A. R. Johnston

JPL Publication 78-32, February 1978

For abstract, see Hilbert, E E

CARLSON, R. W.

- C005 Sodium D-Line Emission From Io: Comparison of Observed and Theoretical Line Profiles**

R. W. Carlson, D. L. Matson, T. V. Johnson, and
J. T. Bergstrahl

Astrophys J, Vol 223, pp 1082-1086, August 1,
1978

High-resolution spectra of the D-line profiles have been obtained for Io's sodium emission cloud. These lines, which are produced through resonance scattering of sunlight, are broad and asymmetric and can be used to infer source and dynamical properties of the sodium cloud. In this paper we compare line profile data with theoretical line shapes computed for several assumed initial velocity distributions corresponding to various source mechanisms. We also examine the consequences of source distributions which are nonuniform over the surface of Io. It is found that the experimental data are compatible with escape of sodium atoms from the leading hemisphere of Io and with velocity distributions characteristic of sputtering processes. Thermal escape and simple models of plasma sweeping are found to be incompatible with the observations.

- C006 Images of Io's Sodium Cloud**

D. L. Matson, B. A. Goldberg, T. V. Johnson, and
R. W. Carlson

Science, Vol 199, pp 531-533, February 3, 1978

For abstract, see Matson, D L

CARTWRIGHT, D. C.

- C007 Cross Sections for Electron Impact Excitation of the Electronic States of N₂**

D. C. Cartwright (Los Alamos Scientific
Laboratory), S. Trajmar, and A. Chutjian

Electronic and Atomic Collisions Tenth Int Conf on the Phys of Electron and At Collisions, Paris, France, July 21-27, 1977, pp, 128-129

Normalized differential and integral cross sections have been obtained by the analysis of electron energy-loss spectra in N₂ for the excitation of the lowest three singlet, lowest five triplet valence electronic states, the two Rydberg states, and the nine singlet and triplet states between 12.5 and 13.4 eV above the ground state.

CASAD, T. A.

- C008 Characterization of Solar Cells for Space Application: Electrical Characteristics of OCLI Violet Solar Cells as a Function of Intensity and Temperature**

T. A. Casad, R. G. Downing, and R. S. Weiss

JPL Publication 78-15, Vol 1, March 15, 1978

Electrical characteristics of OCLI violet N/P silicon solar cells are presented in graphical and tabular format as a function of solar illumination intensity and temperature.

CHAI, V. W.

- C009 JPL Energy Consumption Program (ECP) Documentation: A Computer Model Simulating Heating, Cooling and Energy Loads in Buildings**

F. L. Lansing, V. W. Chai, S. N. Higgins,
D. Lascu, R. Urbanajo, and P. Wong

JPL Publication 78-76, September 15, 1978

For abstract, see Lansing, F L

- C010 Performance of Solar-Powered Vapor-Jet Refrigeration Systems with Selected Working Fluids**

V. W. Chai and F. L. Lansing

The Deep Space Network Progress Report 42-44
January and February 1978, pp 245-251,
April 15, 1978

The performance of the solar-powered vapor-jet refrigeration scheme is compared with five selected working fluids R-11, R-12, R-113, Butane and Water. These fluids were selected among those able to suit both a power cycle and a refrigeration cycle. The results indicated that water has the highest coefficient of performance and differs by a wide margin compared to the other compound organic fluids at all boiler and evaporator temperatures considered.

C011 Energy Consumption Program—A Computer Model Simulating Energy Loads in Buildings

F. W. Stoller, F. L. Lansing, V. W. Chai, and
S. Higgins

The Deep Space Network Progress Report 42-45
March and April 1978, pp 288-293, June 15,
1978

For abstract, see Stoller, F. W.

CHAO, C. C.

C012 A Demonstration of Dual Spacecraft Tracking Conducted With the Viking Spacecraft During the Approach Phase

C. C. Chao

The Deep Space Network Progress Report 42-43
November and December 1977, pp 50-66,
February 15, 1978

The potential improvements in navigation capability of dual spacecraft tracking have been demonstrated using Viking approach data. Under unfavorable conditions of large plasma noise, low spacecraft declination and large Earth-spacecraft distance, the dual spacecraft tracking technique improved the Viking B approach accuracy based on short-arc radio metric data, by a factor of 7, to less than 200 km at Mars Orbit Insertion (MOI) minus 3 days. From the results of an analytical expansion and the Viking demonstration with a large intentional error in Mars ephemeris, we are able to conclude that dual spacecraft data types are insensitive to ephemeris error. Results also reveal the potential reduction of tracking time requirements during planet approach.

C013 Mission Applications of the Dual Spacecraft Tracking Technique

C. C. Chao and J. P. McDanell

The Deep Space Network Progress Report 42-43
November and December 1977, pp 82-89,
February 15, 1978

This article discusses the potential application of the dual spacecraft tracking technique to the Voyager mission. First, the concept and technology status is reviewed briefly. Then results pertaining to the JSX-Uranus option Saturn encounter, where potential navigation benefits are greatest, are presented. Results for a Jupiter encounter demonstration also are given and, finally, software modifications and tracking requirements are discussed.

C014 A Demonstration of Differenced Dual-Station One-Way Doppler Conducted with Pioneer 11

C. C. Chao, V. J. Ondrasik, and H. L. Siegel

The Deep Space Network Progress Report 42-45
March and April 1978, pp 104-110, June 15,
1978

In early 1976 simultaneous one-way doppler demonstrations were performed on Pioneer 11. The data noise of the differenced one-way doppler as computed from the pseudo residuals is around 0.002 Hz, which is nearly an order of magnitude smaller than the one-way doppler noise and about the same as differenced two-way/three-way doppler noise.

This report describes the demonstration results and discusses the applicability of differenced one-way radio metric data to spacecraft navigation.

CHEESEBOROUGH, J. C., III

C015 Elastic and Inelastic Scattering of Electrons by Atomic Manganese

W. Williams, J. C. Cheeseborough III (Claremont Men's College), and S. Trajmar

J Phys B At Mol Phys, Vol 11, No 11,
pp 2031-2036, 1978

For abstract, see Williams, W.

CHEN, C. J.

C016 Long-Duration High-Efficiency Operation of a Continuously Pulsed Copper Laser Utilizing Copper Bromide as a Lasant

C. J. Chen, A. M. Bhanji, and G. R. Russell

Appl Phys Lett, Vol 33, No 2, pp 146-148,
July 15, 1978

A copper laser utilizing copper bromide as a lasant and neon as the buffer gas has been operated at an average laser power of between 16 and 19.5 W for a period of 68

h Lasing was attained at a pulsing rate of 16.7 kHz in a quartz discharge tube 2.5 cm in diameter with an electrode separation of 200 cm. The laser energy/pulse and peak power/pulse corresponding to an average power of 19.5 W are 1.2 mJ and 30 kW, respectively. The ratio of laser power at 510.6 and 578.2 nm varied from 3.9 to 1.1 corresponding to a total average laser power of 4 and 18 W, respectively. The highest wall plug and capacitor efficiency measured during 68 h of operation was 0.7 and 1.1%, respectively.

CHEN, C. P.

C017 Multi-Wire Slurry Wafering Demonstrations

C. P. Chen

JPL Publication 78-37, February 22, 1978

A series of ten slicing demonstrations on a multi-wire slurry saw, manufactured by Yasunaga Engineering Company of Japan and distributed by GEOS Corporation of Stamford, Connecticut, was made to evaluate the silicon ingot wafering capabilities. The results revealed that the present sawing capabilities can provide usable wafer area from an ingot 1.05 m²/kg (e.g. kerf width 0.135 mm and water thickness 0.265 mm). Satisfactory surface qualities and excellent yield of silicon wafers were found. One drawback is that the add-on cost of producing wafer from this saw, as presently used, is considerably higher than the systems being developed by Varian and Crystal Systems for the Low-cost Silicon Solar Array Project (LSSA), Task II, primarily because the Yasunaga saw uses a large quantity of wire. The add-on cost can be significantly reduced by extending the wire life and/or by reuse of properly plated wire to restore the diameter.

Prepared for the Department of Energy, DOE/JPL-1012-78/7, Distribution Category UC-63B

CHEN, J. C.

C018 Summary of Voyager Design and Flight Loads

J. C. Chen, J. A. Garba, and F. D. Day III

JPL Publication 78-74, September 1, 1978

Estimates of flight loads for Voyager 1 and Voyager 2 are summarized. These member loads are obtained by using the measured flight accelerations at the launch vehicle/spacecraft interface as forcing functions for the Voyager mathematical model.

The flight loads are compared to the Voyager design loads obtained from the shock spectra/impedance method and to the loads obtained using space vehicle transient loads analysis.

Finally, based on these data, an assessment of the shock spectra/impedance loads method used for Voyager is

presented. Also the following conclusions have been reached: (1) the shock spectra approach provided reasonable conservative design loads for Voyager, (2) care has to be executed to insure that all critical events are accounted for in constructing shock spectra envelopes, (3) the selection of critical events is not always obvious, especially for those flight events wherein the spacecraft dynamic characteristics are important, and (4) the success of the method is strongly dependent on the analyst's experience and judgement.

C019 Finite-Element Solutions for Geothermal Systems

J. C. Chen and J. E. Conel

J. Energy, Vol. 1, No. 6, pp. 364-369, November/December 1977

Using vector potential and scalar potential, the governing equations for a single-component and single-phase geothermal system are formulated. By assuming an initial temperature field, the fluid velocity can be determined which, in turn, is used to calculate the convective heat transfer. The energy equation then is solved by considering convected heat as a distributed source. Using the resulting temperature to compute new source terms, the final results are obtained by iterations of the procedure. Finite-element methods are proposed for modeling of realistic geothermal systems; the advantages of such methods are discussed. The developed methodology then is applied to a sample problem. Favorable agreements are obtained by comparisons to the previous study.

C020 Launch Vehicle Payload Interface Response

J. C. Chen, B. K. Wada, and J. A. Garba

J. Spacecraft Rockets, Vol. 15, No. 1, pp. 7-11, January-February 1978

A method has been developed by which an estimate of the launch vehicle/payload interface response is derived from the interface responses obtained from missions with the identical launch vehicle but different payloads. This method requires the knowledge of the launch vehicle eigenvalues, interface modal displacements, and the dynamic characteristics of the payloads. No other launch vehicle information is required. The organization responsible for the payload is able to perform loads and responses analysis resulting from a payload change without interfacing with the launch vehicle organization.

CHERNOFF, R. C.

C021 Large Active Retrodirective Arrays for Space Applications

R. C. Chernoff

JPL Publication 78-20, January 15, 1978

An active retrodirective array (ARA) electronically points a microwave beam back at the apparent source of an incident pilot signal. Retrodirectivity is the result of phase conjugation of the pilot signal received by each element of the array. The problem of supplying the correct phase reference of the phase conjugation circuit (PCC) associated with each element of the array is solved by "central phasing." By eliminating the need for structural rigidity, central phasing confers a decisive advantage on ARA's as large space-borne antennas. A new form of central phasing suitable for very large arrays is described. ARA's may easily be modified to serve both as transmitting and receiving arrays simultaneously. ARA's are particularly suitable as solar power satellite antennas because they are inherently failsafe. Communication satellites and deep space probes are other suggested applications. Two new kinds of exact, frequency translating PCC's are described. Such PCC's provide the ARA with input-output isolation and freedom from squint. The pointing errors caused by the radial and transverse components of the ARA's velocity, by the propagation medium, and by multipath are discussed. As part of a NASA funded program, a two element ARA breadboard has been built and tested at JPL. Its performance is limited primarily by multipath induced errors.

CHOW, E. Y.

C022 A Highly Accurate Method for the Determination of Mass and Center of Mass of a Spacecraft

E. Y. Chow, A. Egwuatu, and M. R. Trubert

JPL Publication 78-2, April 15, 1978

An extremely accurate method for the measurement of mass and the lateral center of mass of a spacecraft has been developed. The method was needed for the Voyager spacecraft mission requirement which limited the uncertainty in the knowledge of lateral center of mass of the spacecraft system weighing 750 kg to be less than 1.0 mm (0.04 in.)

The method consists of using three load cells symmetrically located at 120° apart on a turntable with respect to the vertical axis of the spacecraft and making six measurements for each load cell. These six measurements are taken by cyclic rotations of the load cell turntable and of the spacecraft, about the vertical axis of the measurement fixture. This method eliminates all alignment, leveling, and load cell calibration errors for the lateral center of mass determination, and permits a statistical best fit of the measurement data. An associated data reduction computer program called MASCM has been written to implement this method and has been used for the Voyager spacecraft. The accuracy obtained was 0.14 mm

(0.006 in.) for the center of mass and 0.01% for the mass determinations.

The method and its associated data reduction computer program have been so designed that they are suitable for any other mass and center of mass determination.

CHRISTENSEN, C. S.

C023 Δ VLBI Spacecraft Tracking System Demonstration: Part I. Design and Planning

D. L. Brunn, R. A. Preston, S. C. Wu, H. L. Siegel, D. S. Brown, C. S. Christensen, and D. E. Hilt

The Deep Space Network Progress Report 42-45
March and April 1978, pp 111-132, June 15, 1978

For abstract, see Brunn, D. L.

CHRISTENSEN, E.

C024 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography: Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle, E. Christensen, D. Farless, J. Mehta, B. Seidel, W. Michael, Jr. (Langley Research Center), A. Wallis (Langley Research Center), and M. Grossi (Raytheon Company)

J. Geophys. Res., Vol. 82, No. 28, pp 4317-4324, September 30, 1977

For abstract, see Fjeldbo, G.

CHRISTENSEN, E. J.

C025 The Mass of Phobos From Viking Flybys

E. J. Christensen, G. H. Born, C. E. Hildebrand, and B. G. Williams

Geophys. Res. Lett., Vol. 4, No. 12, pp 555-557, December 1977

The mass of the Martian satellite Phobos has been determined by processing radiometric tracking data obtained from the Viking-1 spacecraft during a series of 14 near encounters which occurred in February 1977. Distances of closest approach ranged from 89 to 213 km from the center of mass of the satellite. Our best estimate for the gravitational constant, GM, of Phobos is $(6.6 \pm 0.8) \times 10^{-4} \text{ km}^3/\text{s}^2$. The corresponding density of Phobos based on a volume estimate of $4800 \pm 960 \text{ km}^3$ from Mariner 9 imaging is $2.0 \pm 0.5 \text{ gm/cm}^3$.

CHUTJIAN, A.

C026 Cross Sections for Electron Impact Excitation of the Electronic States of N_2

D. C. Cartwright (Los Alamos Scientific Laboratory), S. Trajmar, and A. Chutjian

Electronic and Atomic Collisions Tenth Int Conf on the Phys of Electron and At Collisions, Paris, France, July 21-27, 1977, pp 128-129

For abstract, see Cartwright, D. C.

C027 Electron-Impact Excitation of the Low-Lying Electronic States of HCN

A. Chutjian, H. Tanaka, B. G. Wicke (TRW Systems Group), and S. K. Srivastava

J Chem Phys, Vol 67, No 11, pp 4835-4839, December 1977

The first study of the low-energy electron-impact excitation of low-lying electronic transitions in the HCN molecule is reported. Measurements were made at incident electron energies of 11.6 and 21.6 eV in the energy-loss range of 3-10 eV, and at scattering angles of 20° - 130° . Inelastic scattering spectra were placed on the absolute cross-section scale by determining first the ratio of inelastic-to-elastic scattering cross sections, and then separately measuring the absolute elastic scattering cross section. Several new electronic transitions are observed which are intrinsically overlapped in the molecule itself. Assignments of these electronic transitions are suggested. These assignments are based on present spectroscopic and cross-sections measurements, high-energy electron scattering spectra, optical absorption spectra, and *ab initio* molecular orbital calculations.

C028 Elastic Scattering of Intermediate Energy Electrons by HCN

S. K. Srivastava, H. Tanaka, and A. Chutjian

J Chem Phys, Vol 69, No 4, pp 1493-1497, August 15, 1978

For abstract, see Srivastava, S. K.

CLAFLIN, E. S.

C029 Microwave Radiometer Measurement of Water Vapor Path Delay: Data Reduction Techniques

E. S. Claflin, S. C. Wu, and G. M. Resch

The Deep Space Network Progress Report 42-48 September and October 1978, pp 22-30, December 15, 1978

Unmodeled electrical path delay from atmospheric water vapor is a limiting error source in geodetic measure-

ments made with very long baseline interferometry and in radio ranging to spacecraft. A dual channel water vapor radiometer, operating near the 22.235-GHz water vapor line, is capable of measuring water vapor-induced delay with good accuracy under most weather conditions. Theory shows that water vapor path delay ΔL_v is proportional in a linear combination of saturation-corrected sky brightness temperatures, measured on and off the water vapor line. The second, off-line, channel removes the effects of emission from liquid water droplets in clouds as well as most of the oxygen emission. Tipping curves remove instrumental error. Sky brightness temperatures are saturation-corrected or "linearized" using estimates of effective sky temperature made from surface temperature. Coefficients in the expression for path delay ΔL_v are functions of surface temperature, pressure, and water vapor density, allowing use of our data reduction algorithm at any altitude and in any climate. Coefficients are found by two methods: (1) from a regression analysis of measured brightness temperatures versus radiosonde measured delay, and (2) from a regression of theoretical brightness temperatures versus radiosonde measured delay. Regression solutions are constrained to remove liquid water contributions and to give the correct slope (i.e., one) for radiometer versus radiosonde path delay.

CLAYTON, R. M.

C030 Hydrogen Enrichment for Low-Emission Jet Combustion

R. M. Clayton

Evaporation-Combustion of Fuels, Advances in Chemistry Series No 166, American Chemical Society, Wash., D. C., 1978, pp 267-286

Simultaneous gaseous pollutant emission indexes (g pollutant/kg fuel) for a research combustor with inlet air at 12.09×10^5 N/m² (11.9 atm) pressure and 727 K (849°F) temperature are as low as 1.0 for NO_x and CO and 0.5 for unburned HC. Emissions data are presented for hydrogen/jet fuel (JP-5) mixes and for jet fuel only for premixed equivalent ratios from lean blowout to 0.65. Minimized emissions were achieved at an equivalence ratio of 0.38 using 10-12 mass % hydrogen in the total fuel to depress the lean blowout limit. They were not achievable with jet fuel alone because of the onset of lean blowout at an equivalence ratio too high to reduce the NO_x emission sufficiently.

COHEN, E. A.

C031 The Rotational Spectrum and Molecular Parameters of ClO in the $v = 0$ and $v = 1$ States

R. K. Kakar, E. A. Cohen, and M. Geller

J Mol Spectros, Vol. 70, pp 243-256, 1978

For abstract, see Kakar, R. K

COHEN, N. S.

C032 Nitramine Smokeless Propellant Research—Annual Research Progress Report

N. S. Cohen and L. D Strand

JPL Publication 78-6, November 1977

A transient ballistics and combustion model is derived to represent the closed vessel experiment that is widely used to characterize propellants. The model incorporates the nitramine combustion mechanisms which are contained within the steady-state model developed as part of last year's (FY 1976) research. A computer program is developed to solve the time-dependent equations, and is applied to explain aspects of closed vessel behavior. It is found that the rate of pressurization in the closed vessel is insufficient at pressures of interest to augment the burning rate by time-dependent processes. In the case of nitramine propellants, however, the cratering of the burning surface associated with combustion above break-point pressures augments the effective burning rate as deduced from the closed vessel experiment. Low pressure combustion is significantly affected by the ignition process and, in the case of nitramine propellants, by the developing and changing surface structure. Thus, burning rates deduced from the closed vessel experiment may or may not agree with those measured in the equilibrium strand burner. Application of the model to closed vessel test cases shows good agreement between theory and experiment.

Series of T-burner experiments are performed to compare the combustion instability characteristics of nitramine (HMX)-containing propellants and ammonium perchlorate (AP) propellants. It is found that the inclusion of HMX consistently renders the propellant more stable. Although ash produced by more fuel-rich propellants could have provided mechanical suppression, results from clean-burning propellants permit the conclusion that HMX reduces the acoustic driving.

Additional strand burning rate data are presented which provide further confirmation of the results of the steady-state modeling effect of FY 1976.

Prepared for the United States Air Force

COLBURN, D

C033 Multicolor Observations of Phobos With the Viking Lander Cameras: Evidence for a Carbonaceous Chondritic Composition

J. B. Pollack (Ames Research Center), J. Veverka (Cornell University), K. Pang (Planetary Science Institute), D. Colburn (Ames Research Center), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp 66-69, January 6, 1978

For abstract, see Pollack, J. B

COLE, E. R.

C034 Preliminary Analysis of the Impact of Power Cycling on CTA-21 Equipment Reliability

E. R. Cole

The Deep Space Network Progress Report 42-46 May and June 1978, pp 109-114, August 15, 1978

This article presents the preliminary findings of a study being made at CTA-21 to determine whether Deep Space Station control room equipment power may be turned off to conserve energy. The results of reliability analysis indicate that there may be some correlation between the observed increase in failure rate and cycling of equipment power in the eight-month study period.

COLEMAN, L. B.

C035 On the Crystal Phases of (DEPE) (TCNQ)₄

L. B. Coleman (University of California, Davis), A. M. Hermann (Tulane University), R. Williams (California Institute of Technology), and R. B. Somoano

Phys Stat Sol (B), Vol 82, No 2, pp K117-K121, 1977

X-ray powder diffraction studies of two semiconducting crystal phases in the organic charge transfer salt (DEPE) (TCNQ)₄ has revealed almost identical electrical properties to those of metallic crystals. It is hypothesized that the similarity arises from the nature of the measurements themselves, i.e., electrode geometry. The possibility that a separate metallic phase for (DEPE) (TCNQ)₄ exists is not, however, ruled out.

CONEL, J. E.

C036 A Study of Alteration Associated With Uranium Occurrences in Sandstone and Its Detection by Remote Sensing Methods

J. E. Conel, M. J. Abrams, and A. F. H. Goetz

JPL Publication 78-66, Vols I and II, August 1, 1978

The present study is a detailed investigation of alteration associated with tabular uranium occurrences in the San Raphael Swell, Utah, and remnants of roll-front type deposits in the Powder River Basin, Wyoming. Field and Laboratory spectral reflectance studies on these uranium deposits or occurrences have been carried out. These have been supplemented with mineralogical and chemical analyses to determine the origin of spectral features observed. The principal alteration products are (a) goethite/limonite (Utah deposits) and (b) goethite/limonite and hematite (Wyoming deposits). The principal clay mineral present in the deposits is montmorillonite. Statistical analysis of the field data was performed using a stepwise linear discriminant function analysis computer program. This program determines which combinations of input wavelength bands provide best separation of specified groupings of data. Altered and unaltered rocks could be repeated with 95% accuracy using spectral data including all wavelength bands. Of the satellite-simulated wavelength region tests, Landsat D bands gave the best classification accuracy.

Prepared for the Department of Energy

C037 Finite-Element Solutions for Geothermal Systems

J. C. Chen and J. E. Conel

J Energy, Vol 1, No. 6, pp 364-369, November/December 1977

For abstract, see Chen, J C

CONNOR, B. V.

C038 The ISEE-C Vector Helium Magnetometer

A. M. A. Frandsen, B. V. Connor,
J. Van Amersfoort, and E. J. Smith

IEEE Trans Geosci Electron, Vol GE-16, No 3,
pp 195-198, July 1978

For abstract, see Frandsen, A M A.

CONTEAS, A. D.

C039 A Solar Wind Turbulence Event During the Voyager 1978 Solar Conjunction Profiled via a New DSN Radio Science Data Capability

A. L. Berman and A. D. Contreas

The Deep Space Network Progress Report 42-48
September and October 1978, pp 55-58,
December 15, 1978

For abstract, see Berman, A L

C040 Radial and Solar Cycle Variations in the Solar Wind Phase Fluctuation Spectral Index as Determined From Voyager 1978 Solar Conjunction Data

A. L. Berman and A. D. Contreas

The Deep Space Network Progress Report 42-48
September and October 1978, pp 59-65,
December 15, 1978

For abstract, see Berman, A. L

COSTOGUE, E. N.

C041 High-Power, Ultralow-Mass Solar Arrays: FY-77 Solar Arrays Technology Readiness Assessment Report

E. N. Costogue, L. E. Young (Marshall Space Flight Center), and H. Brandhorst (Lewis Research Center)

JPL Publication 78-48, Vol I, June 15, 1978

This report describes the results of a NASA intercenter effort conducted during FY 1977 to assess the technology readiness of solar array designs for future planetary missions and particularly for the Halley's comet ion drive space vehicle. The effort involved the participation of JPL, MSFC and LeRC for assessment of critical component technology for the development of candidate solar array designs, and for technology development planning. The main body of the report (Volume I) summarizes results and conclusions, of the NASA Centers' efforts. Contractors' reports, which are included in Volume II, present the development activities in detail.

C042 High-Power, Ultralow-Mass Solar Arrays: FY-77 Solar Arrays Technology Readiness Assessment Report

E. N. Costogue, L. E. Young (Marshall Space Flight Center), and H. Brandhorst (Lewis Research Center)

JPL Publication 78-48, Vol II, June 15, 1978

LMSC has been performing a technology development program for a high-power, lightweight solar array system for solar electric propulsion (SEP), since October 1975. The work has been directed to a 66 W/kg requirement with the solar array system capable of performing over the range of 0.3 A.U. to 6.0 A.U. from the sun. In March 1977, LMSC commenced design studies for an ultralightweight solar array system that would meet the requirements of the Halley's Comet Rendezvous (HCR) SEP Mission. Two design concepts for the Extended Performance SEP Solar Array were studied. One is a planar, flat-fold array system in two power level designs, 60 kW and 120 kW at 1 A.U. from the sun. The two power levels are both in two specific power designs, 200

and 240 W/kg. The other design concept is a trough concentrator, flat-fold array system. Two concentrator designs were defined, one is a two-dimensional concentrator and the other is a combined two-dimensional and three-dimensional trough concentrator.

The planar arrays require the use of high efficiency Thin Cells (2 mil and 3 mil) and thin organic cell covers, combined with a lightened version of the SEP Solar Array printed circuit substrate. The concentrator array, because of improved power output at low solar illumination intensity, can meet the HCR Mission power requirements without an ultra-high specific power solar array design and therefore represents a lower technology development risk for the HCR Mission.

The selected baseline array design for the HCR Mission employs a 3-D concentrator with in-blanket flat-fold trough reflectors and movable side reflectors that are positioned to be either aiding concentration or not operating. This design requires the least number of solar cells but based on the launch stowage constraints requires significant articulation to position the arrays in the ready-to-extend position. The alternate concentrator array design is a 2-D design that greatly simplifies launch stowage and deployment of the array wings to the ready-to-extend position. The array blankets and reflector assemblies are stored between the spacecraft and the IUS. More solar cells are required for this design than for the 3-D design. Both the concentrator array designs meet the HCR weight and power requirements with the use of a 5 mil thick, 13 percent covered efficiency solar cell and a 3 mil thick ceria stabilized microsheet cell cover combined with a lightened version of the SEP Solar Array printed circuit substrates.

C043 Parametric Study of Two Planar High Power Flexible Solar Array Concepts

J. A. Garba, D. A. Kudija, B. Zeldin, and E. N. Costogoue

JPL Publication 78-95, December 15, 1978

For abstract, see Garba, J. A.

COULBERT, C. D.

C044 Enclosure Fire Hazard Analysis Using Relative Energy Release Criteria

C. D. Coulbert

JPL Publication 78-51, December 1, 1978

A method for predicting the probable course of fire development in an enclosure is presented. This fire modeling approach uses a graphic plot of five fire development constraints, the Relative Energy Release Criteria (RERC), to bound the heat release rates in an enclosure

as a function of time. The five RERC are (1) flame spread rate, (2) fuel surface area, (3) ventilation, (4) enclosure volume, and (5) total fuel load. They may be calculated versus time based on the specified or empirical conditions describing the specific enclosure, the fuel type and load, and the ventilation. The calculation of these five criteria, using the common basis of energy release rates versus time, provides a unifying framework for the utilization of available experimental data from all phases of fire development. The plot of these criteria reveals the probable fire development envelope and indicates which fire constraint will be controlling during a critical time period. Examples of RERC application to fire characterization and control and to hazard analysis are presented along with recommendations for the further development of the concept.

C045 Application of the Relative Energy Release Criteria to Enclosure Fire Testing

E. J. Roschke and C. D. Coulbert

JPL Publication 78-86, January 1, 1978

For abstract, see Roschke, E. J.

CRANE, I.

C046 DSS 13 Antenna Subsystem Automation

H. Phillips, I. Crane, and P. Lipsius

The Deep Space Network Progress Report 42-46
May and June 1978, pp. 73-75, August 15, 1978

For abstract, see Phillips, H.

CROUCH, M. D.

C047 The Otto-Engine-Equivalent Vehicle Concept

M. W. Dowdy and M. D. Crouch

JPL Publication 78-101, December 15, 1978

For abstract, see Dowdy, M. W.

CUFFEL, R.

C048 Influence of Internally Generated Pure Tones on the Broadband Noise Radiated from a Jet

S. P. Parthasarathy, R. Cuffel, and P. F. Massier

AIAA J., Vol. 16, No. 5, pp. 538-540, May 1978

For abstract, see Parthasarathy, S. P.

CUFFEL, R. F.

C049 Analysis of Heat Losses and Casing Temperatures of Steam Injection Wells With Annular Coolant Water Flow

L. H. Back and R. F. Cuffel

Preprint SPE 7148, Calif Reg Meet SPE, San Francisco, Calif, April 12-14, 1978

For abstract, see Back, L. H.

CULLEN, L. E.

C050 IPL Processing of the Viking Orbiter Images of Mars

R. M. Ruiz, D. A. Elliott, G. M. Yagi,
R. B. Pomphrey, M. A. Power, K. W. Farrell, Jr.,
J. J. Lorre, W. D. Benton, R. E. Dewar, and
L. E. Cullen

J Geophys Res, Vol 82, No 28, pp 4189-4202,
September 30, 1977

For abstract, see Ruiz, R. M.

CUNNINGHAM, R.

C051 A System for Extracting Three-Dimensional Measurements From a Stereo Pair of TV Cameras

Y. Yakimovsky (University of Miami) and
R. Cunningham

Comput Graph Image Process, Vol 7, pp 195-
210, 1978

For abstract, see Yakimovsky, Y.

CURKENDALL, D. W.

C052 Algorithms for Isolating Worst Case Systematic Data Errors

D. W. Curkendall

J Guidance Contr, Vol 1, No 1, pp 56-62,
January-February, 1978

Algorithms which are computationally simple and easy to apply and interpret are derived to investigate filter sensitivity to data error sets which have the most power, for a given norm, to create estimate error. These techniques are applied to a baseline estimation problem using very long baseline interferometry (VLBI) data. The VLBI technique itself is reviewed and the worse case error finding algorithms are motivated by noting that VLBI is a technique that permits great observational flexibility in order to desensitize the estimator to at least some sequences of data error. Finding the worst case

data error sets thus has the twin utilities of 1) specifying what are the otherwise very elusive performance bounds, and 2) suggesting observational strategy modification to build an overall more robust situation.

CUTTING, E.

C053 Seasat-A Opens New Phase in Earth Observations

E. Cutting and E. Pounder

Astronaut Aeronaut, Vol 16, No 6, pp 42-50,
June 1978

The data output of the Seasat-A, the first satellite designed specifically for oceanographic observation, is described. Wave height and direction, ice distribution, surface wind speed and direction, ocean-surface temperature, and atmospheric water content will be monitored by the satellite. Imaging radar, microwave scatterometer, microwave radiometer and visual and infrared radiometer experiments are included in the Seasat-A observing program. Two types of orbits have been developed: a near-repeat cycle of three days, and a near-repeat cycle of 25 days. Both orbit types offer fine coverage (18.5 km crossing separations) of the Earth. Synthetic aperture radar data on computer-compatible tapes and geophysical data records available through the Seasat-A mission are described.

DAILY, M.

D001 Application of Multispectral Radar and LANDSAT Imagery to Geologic Mapping in Death Valley

M. Daily, C. Elachi, T. Farr, W. Stromberg,
S. Williams, and G. Schaber (U. S. Geological
Survey)

JPL Publication 78-19, March 30, 1978

The purpose of this study was to apply the techniques of computer image processing to data sets from sensors operating in visible and microwave wavelengths as an aid to discriminating surficial geologic units.

Side-Looking Airborne Radar (SLAR) images acquired by JPL and Strategic Air Command systems and visible and near-infrared LANDSAT imagery were applied to studies of the Quaternary alluvial and evaporite deposits in Death Valley, California. Unprocessed radar imagery revealed considerable variation in microwave backscatter, generally correlated with surface roughness.

Individual images were registered to a common geographic base by first manually selecting an array of tie-points and then geometrically distorting the images in a computer. The registered images were ratioed, picture element by picture element, then contrast-stretched to enhance the spectral differences.

For Death Valley, LANDSAT imagery is of limited value in discriminating the Quaternary units except for alluvial units distinguishable by presence or absence of desert varnish or evaporite units whose extremely rough surfaces are strongly shadowed

In contrast, radar returns are most strongly dependent on surface roughness, a property more strongly correlated with surficial geology than is surface chemistry. While no single radar band is capable of separating all the surface units, use of two frequencies (1) X-band, $\lambda = 3$ cm and (2), L-band, $\lambda = 25$ cm, and two polarizations (1) vertical-transmit, vertical-receive (VV) and (2) vertical-transmit, horizontal-receive (VH) permits complete separation of all units except the two younger gravel units (Qg_3 and Qg_4 and the *enfant terrible* of the study, the floodplain (Qf). By including any one LANDSAT band, Qg_3 and Qg_4 become distinguishable, while Qf remains intractable.

Microwave scattering mechanisms in the Valley include specular reflection, diffuse (depolarizing), multiple scattering, and the effects of penetration.

DAKSLA, C.

D002 Continuous Extrusion of Coal

C. England, R. Kushida, and C. Daksia

Chem Eng Progr, pp 92-94, August 1978

For abstract, see England, C

DANIELSON, G. E.

D003 Venus in Motion

J. L. Anderson, M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, N. Evans, and J. M. Soha

Astrophys J Suppl Ser, Vol 36, No 2, pp 275-284, February 1978

For abstract, see Anderson, J L

DATTA, T.

D004 Optical, Spin-Resonance, and Magnetoresistance Studies of (Tetrathiatetracene)₂(Iodide)₃. The Nature of the Ground State

R. B. Somoano, S. P. S. Yen, V. Hadek, S. K. Khanna, M. Novotny (Stanford University), T. Datta (Tulane University), A. M. Hermann (Tulane University), and J. A. Woollam (Lewis Research Center)

Phys Rev, Pt B Solid State, Vol 17, No 7, pp 2853-2857, April 1, 1978

For abstract, see Somoano, R B

D005 Electrical Properties of (DEPE) (TCNQ)₄

R. B. Somoano, V. Hadek, S. P. S. Yen, A. Rembaum, C. H. Hsu (California Institute of Technology), R. J. Deck (Tulane University), T. Datta (Tulane University), and A. M. Hermann (Tulane University)

Phys Stat Sol (B), Vol 81, No 1, pp 281-286, 1977

For abstract, see Somoano, R B

DAUD, T.

D006 Effect of Multiblade Slurry Saw Induced Damage on Silicon Solar Cells

T. Daud, J. K. Liu, G. A. Pollock, and K. M. Koliwad

Conf Rec Thirteenth IEEE Photovoltaic Spec Conf, Washington, D C, June 5-8, 1978, pp 142-146

It is well known that the performance of the silicon solar cells fabricated on sawn wafers improves considerably if the saw-induced damage is removed prior to fabrication. The material loss from this removal impacts on the economic viability of ingot technology to meet the requirements of low-cost silicon solar cells. This work was undertaken to measure the optimum etch-loss required for good solar cell performance. The amount of material that needs to be removed depends both on the extent and the nature of the damage induced by the sawing process. It has been noted in the past that the characteristics of the sawing process have considerable influence both on the extent and the nature of the damage. Ten cm diameter wafers cut from a Varian multiblade slurry saw were used in the experiment. Samples with various amounts of damage removed by chemical etching or chemomechanical polishing were processed into solar cells. Cell performance measurements of light and dark I-V and spectral response characteristics were then made as a function of depth of damage removed. Results are presented.

D007 Effect of Copper Impurity on Polycrystalline Silicon Solar Cells

T. Daud and K. M. Koliwad

Conf Rec Thirteenth IEEE Photovoltaic Spec Conf, Washington, D C, June 5-8, 1978, pp 503-506

The presence of copper impurity, up to 10^{15} atoms/cc, in single crystal silicon has been shown to have no deleterious effect on the p-n junction solar cell perform-

ance However, in polycrystalline silicon, copper atoms tend to migrate to the defect sites because of the structural sensitive properties of copper This study was undertaken to investigate the influence of this behavior of copper impurity on the performance of p-n junction solar cells fabricated from structually imperfect silicon

DAVIES, D. W.

D008 Mars' Water Vapor Observations From the Viking Orbiters

C. B. Farmer, D. W. Davies, A. L. Holland, D. D. LaPorte (Santa Barbara Research Center), and P. E. Doms (University of California, Los Angeles)

J Geophys Res, Vol 82, No 28, pp 4225-4248, September 30, 1977

For abstract, see Farmer, C B

DAVIS, E. S.

D009 Process Heat in California. Applications and Potential for Solar Energy in the Industrial, Agricultural and Commercial Sectors

R. H. Barbieri, R. E. Bartera, E. S. Davis, G. E. Hlavka, D. S. Pivrotto, and G. Yanow

JPL Publication 78-33, March 1978

For abstract, see Barbieri, R. H

DAVIS, H. S.

D010 Potential for Cogeneration of Heat and Electricity in California Industry—Phase I Final Report

H. S. Davis, R. M. Gurfield, V. C. Moretti, and M. L. Slonski

JPL Publication 78-42, May 1, 1978

This report summarizes the results of a Phase I study conducted by the Jet Propulsion Laboratory for the California Energy Resources Conservation and Development Commission to determine the potential for cogeneration of heat and electricity in California industry

The primary effort of the Phase I study was to conduct an industrial survey of 12 selected plants in the State of California. Information collected during the study was organized into four categories: technical, economic, environmental, and institutional

In this Phase I study the technical aspects of industrial cogeneration are examined on a site-specific basis Following this work, a Phase II study will investigate further and analyze the site-specific economics, environmental

constraints, and institutional barriers that impact industrial cogeneration.

Prepared for the State of California Energy Resources Conservation and Development Commission.

D011 Proceedings of the Alternate Energy Systems Seminar

M. E. Alper, R. E. Bartera, H. S. Davis, R. G. Forney, C. F. Mohl, H. J. Stewart, and V. C. Truscello

JPL Publication 78-45, March 30, 1978

For abstract, see Alper, M E

DAY, F. D., III

D012 Summary of Voyager Design and Flight Loads

J. C. Chen, J. A. Garba, and F. D. Day III

JPL Publication 78-74, September 1, 1978

For abstract, see Chen, J C

DE GROOT, N. F.

D013 CCIR Papers on Telecommunications for Deep Space Research

N. F. de Groot

The Deep Space Network Progress Report 42-43 November and December 1977, pp. 164-179, February 15, 1978

Three JPL papers on telecommunications for deep space research have been adopted by Study Group 2 of the International Radio Consultative Committee (CCIR) In this article we present the paper that deals with the selection of preferred frequency bands in the 1-20 GHz range Topics include propagation factors, equipment considerations, and communication link performance

D014 Radio Frequency Interference Between Spacecraft in Different Missions

N. F. de Groot

The Deep Space Network Progress Report 42-43 November and December 1977, pp 180-184, February 15, 1978

This article presents the results of a study to determine the possibility of separately receiving signals transmitted in a common frequency band from spacecraft in different missions For the 18 mission pairs that were examined, co-channel operation without interference is generally possible For some mission pairs, co-channel interference would occur during brief post-launch periods Problems

that may arise from simultaneous co-channel Earth-to-space transmission from two stations at a single DSN complex were not considered

D015 CCIR Papers on Telecommunications for Deep Space Research

N. F. de Groot

The Deep Space Network Progress Report 42-44 January and February 1978, pp 211-223, April 15, 1978

Three papers on telecommunications for deep space research have been adopted by Study Group 2 of the International Radio Consultative Committee (CCIR) In this article, we present the paper that considers the sharing of radio frequency bands between deep space research and other radio service

DE LEEUW, W. H.

D016 Infrared Astronomical Satellite

W. I. McLaughlin and W. H. de Leeuw (Fokker-VFW, Netherlands)

Spaceflight, Vol 20, pp 187-191, May 1978

For abstract, see McLaughlin, W I

DECK, R. J.

D017 Electrical Properties of (DEPE) (TCNQ)₄

R. B. Somoano, V. Hadek, S P. S. Yen, A Rembaum, C. H. Hsu (California Institute of Technology), R. J. Deck (Tulane University), T. Datta (Tulane University), and A. M. Hermann (Tulane University)

Phys Stat Sol (B), Vol 81, No 1, pp 281-286, 1977

For abstract, see Somoano, R. B

DeGREY, S. P.

D018 Utilization of Waste Heat in Trucks for Increased Fuel Economy

C. J Leising, G P. Purohit, S P. DeGrey, and J. G. Finegold

JPL Publication 78-39, May 1, 1978

For abstract, see Leising, C J

D019 Waste Heat Recovery in Truck Engines

C. J Leising, G. P. Purohit, S P. DeGrey, and J G. Finegold

Preprint 780686, SAE West Coast Meet , San Diego, Calif , August 7-10, 1978

For abstract, see Leising, C J

DeMORE, W. B.

D020 An Assessment of an F₂ or N₂O₄ Atmospheric Injection From an Aborted Space Shuttle Mission

R. T. Watson, P. E. Smokler, and W. B. DeMore

JPL Publication 77-81, April 15, 1978

For abstract, see Watson, R T

D021 Ultraviolet Absorption Cross Sections of Hydrogen Peroxide

C. L. Lin, N. K. Rohatgi, and W. B. DeMore

Geophys Res Lett, Vol 5, No 2, pp 113-115, February 1978

For abstract, see Lin, C L

D022 Rate Constant for the Reaction of Atomic Chlorine With Methane

C. L. Lin, M. T. Leu, and W. B. DeMore

J Phys Chem, Vol 82, No 16, pp 1772-1777, 1978

For abstract, see Lin, C L

D023 Rate Constant for the Reaction ClO + NO → Cl + NO₂

M. T. Leu and W. B. DeMore

J Phys Chem, Vol 82, No 19, pp 2049-2052, 1978

For abstract, see Leu, M T

DEWAR, R. E.

D024 IPL Processing of the Viking Orbiter Images of Mars

R. M. Ruiz, D. A. Elliott, G. M. Yagi, R. B. Pomphrey, M. A. Power, K. W. Farrell, Jr., J J Lorre, W. D. Benton, R. E. Dewar, and L E. Cullen

J Geophys Res, Vol 82, No 28, pp 4189-4202, September 30, 1977

For abstract, see Ruiz, R M

DICKINSON, R M.

**D025 Microwave Power Transmitting Phased Array
Antenna Research Project Summary Report**

R M. Dickinson

JPL Publication 78-28, December 15, 1978

An initial design study and the development results of an S-band RF power transmitting phased array antenna experiment system that was to be implemented by the Jet Propulsion Laboratory for NASA are presented. The array was to be designed, constructed and instrumented to permit wireless power transmission technology evaluation measurements. The planned measurements were to provide data relative to the achievable performance in the state of the art of flexible surface, retrodirective arrays, as a step in technically evaluating the Satellite Power System (SPS) concept for importing to Earth, via microwave beams, the nearly continuous solar power available in geosynchronous orbit.

This report presents details of the microwave power transmitting phased array (MPTX) design, instrumentation approaches, system block diagrams, and measured component and breadboard characteristics achieved before the project was discontinued.

**D026 The Beamed Power Microwave Transmitting
Antenna**

R. M. Dickinson

IEEE Trans Microwave Theor Tech, Vol MTT-26,
No 5, pp 335-, May 1978

The potential applications, resulting hazards, safety considerations, and alternate options for high-power microwave beam transmission functions are discussed. Existing and projected beamed power control techniques are presented, and the differences between existing and proposed high-power conventional antennas and phased arrays are described.

**D027 SPS Microwave Subsystem Potential Impacts and
Benefits**

R. M. Dickinson

Radiation Energy Conversion in Space, AIAA, New
York, pp 25-35, 1978

The microwave subsystem for delivering solar power in orbit to earth is presented. In particular, the impacts and benefits to society of this electric power delivery system during its development, construction, and operation are discussed. The overall system consists of a fleet of geostationary spacecraft solar collectors and RF converters linked via microwave power transmission beams to multiple ground rectennas. The rectennas collect the microwave power radiated from spacecraft antennas and con-

vert it to dc. The rectenna dc output is further processed to yield either higher voltage dc or ac for interfacing with electric utility grids.

The microwave subsystem impacts range from harmonics and RF noise radiated by the transmitting antenna, through potential interference with ionospheric communications and navigation caused by the power beam heating the ionosphere, to the potential large land area requirements for the rectennas and low-level microwave radiation around the rectennas.

Benefits range from a very low level of waste heat liberated and lack of atmospheric emissions, including noise, while operating to having no residual ionizing radiation from the rectenna when deactivated. The benign nature of the microwave subsystem also considerably reduces the potential threat of disruption by terrorists.

DIGGES, T. G., JR

**D028 Structure of Deformed Silicon and Implications for
Low Cost Solar Cells**

N. Mardesich, M. H. Leibold, G. B. Turner, and
T. G. Digges, Jr

JPL Publication 78-13, March 1, 1978

For abstract, see Mardesich, N

DOBROTIN, B. M.

D029 Fully Automated Urban Traffic System

B. M. Dobrotin, T. K. C. Peng,
G. R. Hansen, and D. A. Rennels

JPL Publication 77-64, December 1977

This report discusses the technical feasibility of automating urban traffic. Urban traffic is defined as non-freeway urban traffic, i.e. the flow of vehicles through city streets. Included within the scope of urban traffic are intersections, parking, left and right hand turns, lane changes and most importantly, interaction between vehicles and the roadside. This latter characteristic includes both vehicles and pedestrians.

The goal of this automation study is to replace the driver with an automatic system which would perform the functions of guiding and routing the vehicle with a human's capability of responding to changing traffic demands. No geographical changes in the urban environment would be allowed.

The problem was divided into four technological areas: guidance, routing, computing and communications. It was determined that the latter three areas were being developed independent of any need for fully automated urban traffic. However, a guidance system that would

meet system requirements was not being developed, but was technically feasible

A guidance system that used TV data processing and dead reckoning navigation was postulated, and a specific development plan recommended

Prepared for the U.S. Department of Transportation, Report No. DOT-TST-78-3

DOMS, P. E.

D030 Mars' Water Vapor Observations From the Viking Orbiters

C. B. Farmer, D. W. Davies, A. L. Holland, D. D. LaPorte (Santa Barbara Research Center), and P. E. Doms (University of California, Los Angeles)

J. Geophys. Res., Vol. 82, No. 28, pp. 4225-4248, September 30, 1977

For abstract, see Farmer, C. B.

DONNER, M. D.

D031 UNIBUS Monitor for PDP 11

M. D. Donner

The Deep Space Network Progress Report 42-46
May and June 1978, pp. 70-72, August 15, 1978

A UNIBUS Monitor has been designed and constructed to facilitate development of hardware interfaces with the PDP 11 minicomputer. The Monitor provides useful displays of UNIBUS conditions and provides the user with a flexible diagnostic tool. It can also serve as a simple display and data entry device, permitting extremely simple input/output for development software.

DOWDY, M.

D032 Automotive Technology Status and Projections: Executive Summary

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol. I, June 1978

Results of an assessment of the status and projections of automotive technology are presented. Factors considered include fuel economy, exhaust emissions, multifuel capability, advanced materials, and cost/manufacturability for both conventional and advanced alternative power systems.

To insure valid comparisons of vehicles with alternative power systems, the concept of an Otto-Engine-Equiva-

lent (OEE) vehicle was utilized. Each engine type was sized to provide equivalent vehicle performance. Sensitivity to different performance criteria was evaluated. Fuel economy projections are made for each engine type considering both the legislated emissions standards (0.4 g/mi HC, 3.4 g/mi CO, 1.0 g/mi NO_x) and possible future emissions requirements (0.4 g/mi NO_x).

Prepared for the Department of Energy

D033 Automotive Technology Status and Projections: Assessment Report

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol. II, June 1978

Results of an assessment of the status and projections of automotive technology are presented. Factors considered include fuel economy, exhaust emissions, multifuel capability, advanced materials, and cost/manufacturability for both conventional and advanced alternative power systems.

To insure valid comparisons of vehicles with alternative power systems, the concept of an Otto-Engine-Equivalent (OEE) vehicle was utilized. Each engine type was sized to provide equivalent vehicle performance. Sensitivity to different performance criteria was evaluated. Fuel economy projections are made for each engine type considering both the legislated emissions standards (0.4 g/mi HC, 3.4 g/mi CO, 1.0 g/mi NO_x) and possible future emissions requirements (0.4 g/mi NO_x).

Prepared for the Department of Energy

DOWDY, M. W.

D034 Automotive Fuel Economy and Emissions Program

M. W. Dowdy and R. L. Baisley

JPL Publication 78-21, June 1978

The purpose of this effort was to generate experimental data to support an assessment of the relationship between automobile fuel economy and emissions control systems. Tests were made at both the engine and vehicle levels. Detailed investigations were made on cold-start emissions devices, exhaust gas recirculation systems, and air injection reactor systems. Based on the results of engine tests, an alternative emission control system and modified control strategy were implemented and tested in the vehicle. With the same fuel economy and NO_x emissions as the stock vehicle, the modified vehicle reduced HC and CO emissions by about 20 percent. By removing the NO_x emissions constraint, the modified vehicle demonstrated about 12 percent better fuel economy than the stock vehicle.

Prepared for the U S Department of Transportation

D035 Evaluation of FIDC System' Final Report

R. A. Hall, M. W Dowdy, and T. W Price

JPL Publication 78-93, October 15, 1978

For abstract, see Hall, R. A

D036 The Otto-Engine-Equivalent Vehicle Concept

M. W Dowdy and M. D. Crouch

JPL Publication 78-101, December 15, 1978

A vehicle comparison methodology based on the Otto-Engine Equivalent (OEE) vehicle concept is described. As an illustration of this methodology, the concept is used to make projections of the fuel economy potential of passenger cars using various alternative power systems. Sensitivities of OEE vehicle results to assumptions made in the calculational procedure are discussed. Factors considered include engine torque boundary, rear axle ratio, performance criteria, engine transient response, and transmission shift logic.

Prepared for the Department of Energy

DOWNING, R. G.

D037 Characterization of Solar Cells for Space Application: Electrical Characteristics of OCLI Violet Solar Cells as a Function of Intensity and Temperature

T. A. Casad, R. G. Downing, and R. S Weiss

JPL Publication 78-15, Vol I, March 15, 1978

For abstract, see Casad, T A

D038 Characterization of Solar Cells for Space Applications: Electrical Characteristics of Solarex 50-Micron Solar Cells as a Function of Intensity and Temperature

R. G. Downing, T. F. Miyahira, and R. S Weiss

JPL Publication 78-15, Vol II, August 15, 1978

Electrical characteristics of Solarex 50-micron-thick N/P silicon solar cells are presented in graphical and tabular format as a function of solar illumination intensity and temperature.

D039 Characterization of Solar Cells for Space Applications: Electrical Characteristics of OCLI Hybrid MLAR Solar Cells as a Function of Intensity and Temperature

R. G Downing and R. S. Weiss

JPL Publication 78-15, Vol III, September 1, 1978

Electrical characteristics of hybrid multilayer antireflectance coated N/P silicon solar cells are presented in graphical and tabular format as a function of solar illumination intensity and temperature.

D040 Characterization of Solar Cells for Space Applications: Electrical Characteristics of Spectrolab BSF 200-Micron Helios Cells as a Function of Intensity and Temperature

R. G Downing and R. S. Weiss

JPL Publication 78-15, Vol IV, November 1, 1978

Electrical characteristics of Spectrolab BSF 200-micron Helios N/P silicon solar cells are presented in graphical and tabular format as a function of solar illumination intensity and temperature.

DUDA, J. R.

D041 A Life-Cycle Description of Underground Coal Mining

M. L. Lavin, C. S. Borden, and J. R. Duda

JPL Publication 78-26, April 1978

For abstract, see Lavin, M L

DUMAS, L.

D042 Environmental Testing of Flat Plate Solar Cell Modules

J. Griffith, L. Dumas, and A. Hoffman

Proc Seminar on Testing Solar Energy Mater Syst, Washington, D C, May 1978, pp 1-11

For abstract, see Griffith, J

DUXBURY, T.

D043 The Puzzling Moons of Mars

J. Veverka (Cornell University), P. Thomas (Cornell University), and T. Duxbury

Sky Telesc, Vol 56, pp 186-189, September 1978

For abstract, see Veverka, J

DUXBURY, T. C.

D044 Viking Imaging of Phobos and Deimos: An Overview of the Primary Mission

T C. Duxbury and J Veverka (Cornell University)

J Geophys Res, Vol 82, No 28, pp 4203-4211, September 30, 1977

The Viking primary mission (June 20 to November 15, 1976) yielded approximately 50 images of Phobos and Deimos. These pictures completed the surface coverage of Phobos begun by Mariner 9 in 1971-1972 and extended the coverage of Deimos. The effective resolution of the Viking images exceeds that obtained by Mariner 9 for two main reasons: improved camera performance and closer encounter distances. The improved resolutions revealed a number of unexpected surface features such as linear chains of irregular craters and elongated grooves and striations. The Viking coverage has provided the first high-resolution color information on the surfaces of the two satellites and has extended the phase angle coverage to 125°. Additionally, a number of images of the satellites were obtained against star backgrounds to refine further the ephemerides.

D045 Viking Observations of Phobos and Deimos: Preliminary Results

J. Veverka (Cornell University) and T. C. Duxbury

J Geophys Res, Vol 82, No 28, pp 4213-4223, September 30, 1977

For abstract, see Veverka, J

D046 Phobos Transit of Mars as Viewed by the Viking Cameras

T. C. Duxbury

Science, Vol 199, pp 1201-1202, March 17, 1978

A Viking orbiting spacecraft successfully obtained pictures of the martian satellite Phobos with Mars in the background. This is the first time that a single picture was obtained from a spacecraft which contained both a planet and a moon and had significant surface detail visible on both. The region of Mars below Phobos included volcanoes in the Tharsis Montes region. These pictures showed Phobos to be smaller than previously thought. The image of Phobos can be used as a control point to determine the map coordinates of surface features on Mars.

D047 Deimos Encounter by Viking: Preliminary Imaging Results

T. C. Duxbury and J. Veverka (Cornell University)

Science, Vol 201, pp 812-814, September 1, 1978

Recent close flybys of Deimos by Viking revealed a smooth-appearing surface, void of grooves. Higher-resolution pictures showed that the surface was actually covered with craters but that a regolith filled the smaller craters, giving the smooth appearance. The surface was

also covered with boulders and bright streak-like markings analogous to base-surge or ejecta cloud deposits.

D048 Spacecraft Imaging of Phobos and Deimos

T. C. Duxbury

Vistas in Astron, Vol 22, pp 149-161, 1978

This paper describes imaging data obtained from spacecraft orbiting Mars, and discusses both lower and higher resolution pictures. While Mariner and Viking spacecraft normally fly by Phobos and Deimos at distances greater than 4000 km, occasionally flybys as close as a few thousand kilometers occur. The orbits of the two Viking spacecraft were changed to allow flybys within 100 km of the surfaces. Flybys at distances greater than 4000 km yielded lower resolution pictures that detected features larger than 200 meters. The closer flybys obtained higher resolution pictures that detected features as small as 10 to 200 meters.

The lower resolution pictures proved well suited for determining the sizes, shapes, photometric functions, rotational properties, libration amplitudes, libration periods, and ephemerides of the Martian satellites, as well as the gravity field, spin axis direction, and internal structure of Mars. Higher resolution pictures proved additionally valuable for determining topography, geologic and cartographic maps, albedo, color, regolith depth and distribution, and crater morphology, size-frequency, and distribution, as well as for detecting small scale features such as surface fractures, crater chains, wall slumping of craters, base-surge deposits, pool melting, and boulders either swept up by the orbiting satellites or ejected from craters.

DZURISIN, D.

D049 Modification of Fresh Crater Landforms: Evidence From the Moon and Mercury

M. C. Malin and D. Dzurisin (California Institute of Technology)

J Geophys Res, Vol 83, No B1, pp 233-243, January 10, 1978

For abstract, see Malin, M C

EDELSON, R. E.

E001 Extraterrestrial Intelligence: An Observational Approach

B. C. Murray, S. Gulkis, and R. E. Edelson

Science, Vol 199, pp 485-492, February 3, 1978

For abstract, see Murray, B C

EDMISTON, W.

**E002 Automotive Technology Status and Projections:
Executive Summary**

M. Dowdy, A. Burke, H. Schneider, W. Edmiston,
G. Klose, and R. Heft

JPL Publication 78-71, Vol I, June 1978

For abstract, see Dowdy, M

**E003 Automotive Technology Status and Projections:
Assessment Report**

M. Dowdy, A. Burke, H. Schneider, W. Edmiston,
G. Klose, and R. Heft

JPL Publication 78-71, Vol II, June 1978

For abstract, see Dowdy, M

EGWUATU, A.

**E004 A Highly Accurate Method for the Determination of
Mass and Center of Mass of a Spacecraft**

E. Y. Chow, A. Egwuatu, and M. R. Trubert

JPL Publication 78-2, April 15, 1978

For abstract, see Chow, E Y

EISENBERGER, I.

**E005 The Role of Interest and Inflation Rates in Life-
Cycle Cost Analysis**

I. Eisenberger, D. S. Remer, and
G. Lorden (California Institute of Technology)

*The Deep Space Network Progress Report 42-43
November and December 1977, pp 105-109,
February 15, 1978*

The effect of projected interest and inflation rates on life-cycle cost calculations is discussed and a method is proposed for making such calculations which replaces these rates by a single parameter. Besides simplifying the analysis, the method clarifies the roles of these rates. An analysis of historical interest and inflation rates from 1950 to 1976 shows that the proposed method can be expected to yield very good projections of life-cycle cost even if the rates themselves fluctuate considerably.

**E006 Economic Evaluation of DSS 13 Unattended
Operations Demonstration**

D. S. Remer (Harvey Mudd College),
I. Eisenberger, and G. Lorden (California Institute
of Technology)

*The Deep Space Network Progress Report 42-45
March and April 1978, pp 165-171, June 15,
1978*

For abstract, see Remer, D S

ELACHI, C.

**E007 Application of Multispectral Radar and LANDSAT
Imagery to Geologic Mapping in Death Valley**

M. Daily, C. Elachi, T. Farr, W. Stromberg,
S. Williams, and G. Schaber (U S Geological
Survey)

JPL Publication 78-19, March 30, 1978

For abstract, see Daily, M

**E008 Preliminary Studies of Electromagnetic Sounding of
Cometary Nuclei**

A. Gabriel, L. Warne, S. Bednarczyk, and
C. Elachi

JPL Publication 78-44, October 1, 1978

For abstract, see Gabriel, A

**E009 Synthetic Aperture Radar Imagery of the AIDJEX
Triangle**

L. Bryan, T. Farr, F. Leberl, and C. Elachi

AIDJEX Bull, No 37, pp 161-187,
September 1977

For abstract, see Bryan, L

E010 Radar Imaging of the Ocean Surface

C. Elachi

Boundary-Layer Meteorol, Vol 13, pp 165-179,
1978

Radar sensors are being used to provide two-dimensional imagery of the ocean surface. The radar image has a brightness variation which is proportional to the local backscatter cross-section of the surface at the wavelength of observation. The backscatter cross-section is, in turn, a function of the local surface topography and, in the case of a coherent radar system, of the surface dynamics. The synthetic-aperture radar imaging technique produces very high resolution images essentially independent of the distance to the surface being imaged. This technique is discussed in some detail. The emphasis is on recent observations of a large variety of ocean surface patterns. Deep ocean waves have been observed under a variety of weather conditions, including hurricanes. Breaking waves are observed because of the increase in roughness and the presence of foam. Discrete wave-like patterns, which resemble internal wave trains, have been observed in

numerous locations, and eddy-shaped, linear, curvilinear and periodic slicks have also been seen. The different models for wave image formations are briefly reviewed. Specifically, the roughness modulation, tilt modulation, and orbital velocity models are discussed. Finally, it is shown that surface randomness does not destroy the coherence of the signal needed to generate the synthetic-aperture image because of the short-term coherence of the small Bragg waves.

E011 Equipotential Doming in Flooded Circular Basins on the Moon

L. E. Roth, C. Elachi, and R. J. Phillips

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 643-654

For abstract, see Roth, L. E.

ELLEMAN, D. D.

E012 Calculation of Spin-Lattice Relaxation During Pulsed Spin Locking in Solids

W. K. Rhim, D. P. Burum (California Institute of Technology), and D. D. Elleman

J Chem Phys, Vol 68, No 2, pp 692-695, January 1978

For abstract, see Rhim, W. K.

E013 A Multiple Pulse Zero Crossing NMR Technique, and Its Application to ^{19}F Chemical Shift Measurements in Solids

D. P. Burum (California Institute of Technology), D. D. Elleman, and W. K. Rhim

J Chem Phys, Vol 68, No 3, pp 1164-1169, February 1978

For abstract, see Burum, D. P.

E014 New Technique for Single-Scan T_1 Measurements Using Solid Echoes

D. P. Burum, D. D. Elleman, and W. K. Rhim

Rev Sci Instrum, Vol 49, No 8, pp 1169-1175, August 1978

For abstract, see Burum, D. P.

ELLIOTT, D. A.

E015 IPL Processing of the Viking Orbiter Images of Mars

R. M. Ruiz, D. A. Elliott, G. M. Yagi, R. B. Pomphrey, M. A. Power, K. W. Farrell, Jr., J. J. Lorre, W. D. Benton, R. E. Dewar, and L. E. Cullen

J Geophys Res, Vol 82, No 28, pp 4189-4202, September 30, 1977

For abstract, see Ruiz, R. M.

ELSON, L. S.

E016 Barotropic Instability in the Upper Atmosphere of Venus

L. S. Elson

Geophys Res Lett, Vol 5, No 7, pp 603-605, July 1978

Using a barotropic model, the upper atmosphere of Venus is examined for stability to small perturbations of a mean zonal wind. Several assumed mean zonal wind profiles, compatible with Mariner 10 UV observations, are examined with the result that some are stable, while others are unstable. At least one of the unstable profiles exhibits a maximum in the growth rate for wavenumber 3, in agreement with some UV observations of the clouds of Venus. The barotropic model should be useful for performing instability analyses using Pioneer Venus data in 1979.

ENGLAND, C.

E017 Continuous Extrusion of Coal

C. England, R. Kushida, and C. Daksia

Chem Eng Progr, pp 92-94, August 1978

This paper discusses the technology for getting coal into a plastic state so that it can be handled as a fluid, much like a residual oil.

E018 New Method of Feeding Coal: Continuous Extrusion of Fully Plastic Coal

P. R. Ryason and C. England

Fuel, Vol 57, pp 241-244, April 1978

For abstract, see Ryason, P. R.

ERCEGOVAC, M.

E019 A Study of Standard Building Blocks for the Design of Fault-Tolerant Distributed Computer Systems

D. A. Rennels, A. Avizienis (University of California, Los Angeles), and M. Ercegovac (University of California, Los Angeles)

Proc Eighth Annu Int Conf on Fault-Tolerant Computing, Toulouse, France, June 21-23, 1978, pp 144-149

For abstract, see Rennels, D. A.

ERNEST, F. P.

E020 Progress Towards High Efficiency Polycrystalline Thin-Film GaAs AMOS Solar Cells

Y. C. M. Yeh, F. P. Ernest, and R. J. Stirn

Conf Rec Thirteenth IEEE Photovoltaic Spec Conf, Washington, D C, June 5-8, 1978, pp 966-971

For abstract, see Yeh, Y. C. M.

ERNEST, J. B.

E021 Final Report for Phase I—Coal Desulfurization by Low Temperature Chlorinolysis

J. J. Kalvinskas, G. C. Hsu, J. B. Ernest, D. F. Andress, and D. R. Feller

JPL Publication 78-8, November 23, 1977

For abstract, see Kalvinskas, J. J.

ESCOBAL, P. R.

E022 Multilaterating the GEOS-3 Satellite

P. R. Escobal, J. F. Gallagher (Computer Sciences Corporation), and O. H. von Roos

J Astronaut Sci, Vol XXV, No 3, pp 227-249, July-September, 1977

It is demonstrated by means of rigorous simulations with an operational software system that multilateration of the GEOS-3 satellite is possible. This operation, i.e., the processing of simultaneous range measurements from the satellite to a real world constellation of stations using strictly geometric reduction of the observables, will result in the determination of the interstation coordinates to accuracies approaching those of the data measurements obtained at the stations. The satellite-to-satellite link between the GEOS-3 and ATS-6 can be used to further enhance the station covariance matrix.

ESPOSITO, P. B.

E023 Experimental Determination of Mercury's Mass and Oblateness

P. B. Esposito, J. D. Anderson, and A. T. Y. Ng
COSPAR Space Research, Vol XVII, pp 639-644, 1978

The ratio of the mass of the sun to that of Mercury deduced from the first and third flybys of Mercury by Mariner 10 is $6,023,600 \pm 600$ and $6,023,700 \pm 300$ respectively. Additional analysis should reduce these uncertainties by a factor of 2-5. Assuming an equatorial radius of 2439 km, the mean density of the planet is 5.44 g cm^{-3} . The gravitational oblateness deduced from the first encounter is discussed. Data received from the third encounter are better suited for this determination and yield $J_2 = (8 \pm 6) \times 10^{-5}$. In addition, the Mercury 3 data are shown to be sensitive to local gravity effects or anomalies.

EVANS, D. L.

E024 Radar Observations of a Volcanic Terrain. Askja Caldera, Iceland

D. L. Evans

JPL Publication 78-81, October 1, 1978

Surface roughness spectra of nine radar backscatter units in the Askja Caldera region of Iceland were predicted from computer-enhanced like- and cross-polarized radar images. A field survey of the caldera was then undertaken to check the accuracy of the preliminary analysis. There was good agreement between predicted surface roughness of backscatter units and surface roughness observed in the field. In some cases, variations in surface roughness could be correlated with previously mapped geologic units.

EVANS, N.

E025 Venus in Motion

J. L. Anderson, M. J. S. Belton (Kitt Peak National Observatory), G. E. Danielson, N. Evans, and J. M. Soha

Astrophys J Suppl Ser, Vol 36, No 2, pp 275-284, February 1978

For abstract, see Anderson, J. L.

EVANS, N. J., II

E026 Carbon Recombination-Line Mapping of the Orion Nebula

T. B. H. Kuiper and N. J. Evans II (University of Texas, Austin)

Astrophys J, Vol 219, pp 141- 147, January 1, 1977

For abstract, see Kuiper, T B H

EVANS, R. H.

E027 DSN Ground Communications Facility

R. H. Evans

The Deep Space Network Progress Report 42-43
November and December 1977, pp 9-17,
February 15, 1978

A functional description of the GCF and its relationships with other elements of the DSN and NASCOM is presented together with development objectives and goals and comments on implementation activities in support of Flight Projects

EVENSIZER, J.

E028 A Market Survey of Geothermal Wellhead Power Generation Systems: Final Report

M. W. Leeds and J. Evensizer

JPL Publication 78-29, March 1978

For abstract, see Leeds, M W

FANALE, F. P.

F001 Mars: Regolith Adsorption and the Relative Concentrations of Atmospheric Rare Gases

F. P. Fanale, W. A. Cannon, and T. Owen (State University of New York, Stony Brook)

Geophys Res Lett, Vol 5, No 1, pp 77-80,
January 1978

Laboratory measurements of Kr and Xe adsorption on samples of ground montmorillonite, limonite and basalt at -77°C have been performed. Results suggest that 1) most degassed martian Xe could be adsorbed on a regolith with a large effective surface area, and 2) if this is the case the elemental composition of martian nonradio-genic rare gas (counting that in the regolith) may be virtually identical to that of ordinary chondrites

F002 Mars: The Role of the Regolith in Determining Atmospheric Pressure and the Atmosphere's Response to Insolation Changes

F. P. Fanale and W. A. Cannon

J Geophys Res, Vol 83, No B5, pp 2321-2325,
May 10, 1978

We present a quantitative model for atmosphere-regolith exchange of CO_2 on Mars based on new laboratory measurements of CO_2 adsorption on ground rock at temperatures of 158° , 175° , 196° , and 231°K and CO_2 pressures from 10 to 80 mbar. Our model is consistent with Viking observations, whereas models involving a massive residual CO_2 cap and no long-term atmosphere-regolith CO_2 exchange are not. Our model describes the role of the regolith as a CO_2 storehouse, as a long-term buffer of the atmospheric pressure, and as a major factor in determining the response of the atmosphere to postulated changes in surface insolation. We conclude the following: (1) The atmosphere-plus-cap system is buffered on a long-term basis by several hundred grams per square centimeter of exchangeable CO_2 adsorbed in the regolith. (2) If the atmosphere-plus-cap system were arbitrarily removed in its entirety, it would eventually be restored to nearly its former state by reequilibration with the regolith. (3) Exchange with the adsorbed phase in the regolith has greatly restricted ^{18}O enrichment in the atmosphere. (4) The layered terrain primarily represents current periodic pressure increases (of several tens of millibars) caused by exchange of CO_2 between the regolith and the atmosphere-plus-cap system. (5) Pressures of 100-300 mbar might have existed during the early history of the planet.

F003 Asteroids and Comparative Planetology

D. L. Matson, F. P. Fanale, T. V. Johnson, and G. J. Veeder

Proc. Seventh Lunar Sci. Conf., Houston, Tex., March 15-19, 1976, pp 3603-3627

For abstract, see Matson, D L

FARLESS, D.

F004 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography: Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle, E. Christensen, D. Farless, J. Mehta, B. Seidel, W. Michael, Jr. (Langley Research Center), A. Wallio (Langley Research Center), and M. Grossi (Raytheon Company)

J Geophys Res, Vol 82, No 28, pp 4317-4324,
September 30, 1977

For abstract, see Fjeldbo, G

FARLESS, D. L.

- F005 Orbit Trim Maneuver Design and Implementation for the 1975 Mars Viking Mission**

G. R. Hintz, D. L. Farless, and M. J. Adams

Preprint 78-1394, AIAA/AAS Astrodyn Conf, Palo Alto, Calif, August 7-9, 1978

For abstract, see Hintz, G. R.

FARMER, C. B.

- F006 Mars Water Vapor Observations From the Viking Orbiters**

C. B. Farmer, D. W. Davies, A. L. Holland, D. D. LaPorte (Santa Barbara Research Center), and P. E. Doms (University of California, Los Angeles)

J Geophys Res, Vol 82, No 28, pp 4225-4248, September 30, 1977

The results of observations of the spatial and temporal variation of water vapor during the Viking primary mission are reported. The instrument, the Mars atmospheric water detector (Mawd), is a five-channel grating spectrometer operating in the 1.4 μ m water vapor bands. The seasonal period covered here is the northern summer solstice to the following equinox. The global water vapor, mapped at low resolution at approximately 1-month intervals, has been observed to undergo a gradual redistribution, the latitude of maximum column abundance moving from the northern polar area to the equatorial latitudes, and the integrated global atmospheric vapor content remaining constant. The peak abundances (~ 100 precipitable microns) occurred over the dark material of the circumpolar region. The summer residual cap is dirty water ice, at the season of maximum vapor the atmosphere above it is saturated and has a stable lapse rate of temperature. High-resolution maps show local structure controlled by abrupt changes of surface elevation, suggesting that large variations at a given latitude are orographic in nature and only occur in association with features whose horizontal scale is small in comparison to the product of the atmospheric relaxation time and the local mean wind speed. These results are at variance with the low-resolution global maps, however, which seem to show topographic control even at the regional scale. Attempts to isolate the diurnal variation of the vapor have shown a variety of effects at different latitudes and locations, scattering by dust and condensate particles obscures the intrinsic diurnal variation of the vapor phase. The large diurnal variation reported from earth-based measurements may be largely an observational effect.

FARR, T.

- F007 Application of Multispectral Radar and LANDSAT Imagery to Geologic Mapping in Death Valley**

M. Daily, C. Elachi, T. Farr, W. Stromberg, S. Williams, and G. Schaber (U S Geological Survey)

JPL Publication 78-19, March 30, 1978

For abstract, see Daily, M.

- F008 Synthetic Aperture Radar Imagery of the AIDJEX Triangle**

L. Bryan, T. Farr, F. Leberl, and C. Elachi

AIDJEX Bull, No. 37, pp 161-187, September 1977

For abstract, see Bryan, L.

FARR, T. G.

- F009 Computer Processing of SAR L-Band Imagery**

M. L. Bryan, W. D. Stromberg, and T. G. Farr

Photogram Eng Remote Sensing, Vol 43, No 10, pp 1283-1294, October 1977

For abstract, see Bryan, M. L.

FARRELL, K. W., JR.

- F010 A Synoptic Description of Coal Basins via Image Processing**

K. W. Farrell, Jr. and D. B. Wherry

JPL Publication 78-82, September 1978

An existing image processing system is adapted to describe the geologic attributes of a regional coal basin. This scheme handles a map as if it were a matrix, in contrast to more conventional approaches which represent map information in terms of linked polygons. The utility of the image processing approach is demonstrated by a multiattribute analysis of the Herrin No. 6 coal seam in Illinois. Findings include the location of a resource and estimation of tonnage corresponding to constraints on seam thickness, overburden, and Btu value, which are illustrative of the need for new mining technology.

Prepared for the U S Department of Energy, FE/9036-3, Distribution Category UC-88

- F011 IPL Processing of the Viking Orbiter Images of Mars**

R. M. Ruiz, D. A. Elliott, G. M. Yagi,
R. B. Pomphrey, M. A. Power, K. W. Farrell, Jr.,
J. J. Lorre, W. D. Benton, R. E. Dewar, and
L. E. Cullen

J Geophys Res, Vol 82, No 28, pp 4189-4202,
September 30, 1977

For abstract, see Ruiz, R M

FELLER, D. R.

F012 Final Report for Phase I—Coal Desulfurization by Low Temperature Chlorinolysis

J. J. Kalvinskas, G. C. Hsu, J. B. Ernest,
D. F. Andress, and D. R. Feller

JPL Publication 78-8, November 23, 1977

For abstract, see Kalvinskas, J J

FERRARI, A. J.

F013 The Isostatic State of the Lunar Apennines and Regional Surroundings

A. J. Ferrari, D. L. Nelson (California Institute of Technology), W. L. Sjogren, and R. J. Phillips

J Geophys Res, Vol 83, No B6, pp 2863-2871,
June 10, 1978

High-resolution gravity and topography data taken over the Apennine Mountains have been used to compute their isostatic state. Results show that the Apennines are uncompensated, thus this state implies that the lunar crust and upper mantle have been strong enough over 3.9 by to support the load exerted by this topographic excess. The Apennines produce a maximum shear stress of 60 bars at a depth of 60 km. A lower bound on the lunar crustal viscosity of 1×10^{27} P is calculated on the basis of the assumption of a 10% relaxation over 3.9 by. Studies of a broad negative regional anomaly located between Maria Serinitatis and Imbrium necessitate a locally thicker crust to satisfy the observed data. This anomaly may have been produced by a lateral transport of crustal material from beneath the giant impact basins as a result of rebound at the crust-mantle interface.

F014 Mars Topography Harmonics and Geophysical Implications

B. G. Bills (California Institute of Technology) and
A. J. Ferrari

J Geophys Res, Vol 83, No B7, pp 3497-3508,
July 10, 1978

For abstract, see Bills, B G

F015 An Improved Lunar Moment of Inertia Determination: A Proposed Strategy

M. P. Ananda, A. J. Ferrari, and W. L. Sjogren

Moon, Vol 17, pp 101-120, 1977

For abstract, see Ananda, M P

FINEGOLD, J. G.

F016 Utilization of Waste Heat in Trucks for Increased Fuel Economy

C. J. Leising, G. P. Purohit, S. P. DeGrey, and
J. G. Finegold

JPL Publication 78-39, May 1, 1978

For abstract, see Leising, C J

F017 Waste Heat Recovery in Truck Engines

C. J. Leising, G. P. Purohit, S. P. DeGrey, and
J. G. Finegold

Preprint 780686, SAE West Coast Meet, San
Diego, Calif, August 7-10, 1978

For abstract, see Leising, C J

FINNIE, C.

F018 Hydrogen Maser Frequency Standard Computer Model for Automatic Cavity Tuning Servo Simulations

P. D. Potter and C. Finnie

The Deep Space Network Progress Report 42-47
July and August 1978, pp 29-38, October 15,
1978

For abstract, see Potter, P D

FISHER, G. L.

F019 The DSN Standard Real-Time Language

R. L. Schwartz, G. L. Fisher, and
R. C. Tausworthe

The Deep Space Network Progress Report 42-44
January and February 1978, pp 131-138,
April 15, 1978

For abstract, see Schwartz, R L

FIKSK, L. A.

F020 The Energetic Particle Environment of the Solar Probe Mission—As Estimated by the Participants in the Solar Probe Environment Workshop

M. Neugebauer, L. A. Fisk, R. E. Gold, R. P. Lin, G. Newkirk, J. A. Simpson, and M. A. I. Van Hollebeke

JPL Publication 78-64, September 1, 1978

For abstract, see Neugebauer, M

FITCH, J. P.

F021 Effect of a Changing G on the Moment of Inertia of the Earth

R. A. Lyttleton and J. P. Fitch (Institute of Astronomy, Cambridge, England)

Astrophys J, Vol 221, pp 412–413, April 15, 1978

For abstract, see Lyttleton, R. A.

F022 On the Accelerations of the Moon and Sun, the Constant of Gravitation, and the Origin of Mountains

R. A. Lyttleton and J. P. Fitch (Institute of Astronomy, Cambridge, England)

Moon and Planets, Vol 18, pp 223–240, 1978

For abstract, see Lyttleton, R. A.

FJELDBO, G.

F023 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography: Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle, E. Christensen, D. Farless, J. Mehta, B. Seidel, W. Michael, Jr. (Langley Research Center), A. Wallio (Langley Research Center), and M. Grossi (Raytheon Company)

J Geophys Res, Vol 82, No 28, pp 4317–4324, September 30, 1977

Radio occultation measurements were made at approximately 50 locations on Mars with the Viking Orbiter 1 S (2.3 GHz) and X (8.4 GHz) band tracking links during October 1976. The measurements have been used to study the topography and atmosphere of Mars at latitudes ranging from about 75°S to 70°N. By using the ingress and egress times obtained from the observed limb diffraction effects together with the best ephemerides available for the orbiter and the planet we have deter-

mined the surface elevations at the occultation points relative to the reference areoid. The observations agree with Mariner 9 and radar data to within 2 km. The mean atmospheric pressure at the areoid level was found to be 5.9 mbar during the northern midsummer season, a value which agrees quite well with data obtained at the landing sites. By comparing the new electron density measurements with earlier Mariner data we have determined that the temperature and the plasma scale height of the upper atmosphere appear to be functions of solar activity.

FLIEGEL, H. F.

F024 VLBI/Laser Intercomparison Project: Session 2

H. F. Fliegel

The Deep Space Network Progress Report 42-45 March and April 1978, pp 186–189, June 15, 1978

Recent experiments are described which directly intercompare Very Long Baseline Interferometry (VLBI) with laser ranging to artificial satellites by measuring the vector lengths of the same intercontinental baselines. These experiments are part of the VLBI/Laser Intercomparison Project, a continuing task to assess the suitability of VLBI to various geophysical applications.

FLOWER, D. A.

F025 A Microwave Pressure Sounder

D. A. Flower and G. E. Peckham (Heriot-Watt University, Edinburgh, Scotland)

JPL Publication 78-68, August 1, 1978

This report describes a Microwave Pressure Sounder (MPS) based on an active millimeter wave technique. It shows that global-ocean coverage is attainable with sufficient accuracy, resolution and observational frequency for meteorological, oceanographic and climate research applications. It also examines such global coverage of pressure measurement for a variety of implementation schemes. Oceanic coverage which is comparable to the existing density of data points on the continental land masses can be achieved with a network of three instruments in sun synchronous, near-polar orbits.

An ongoing UK-US development program is being directed towards an early proof-of-concept flight for the MPS on a Shuttle/Spacelab sortie mission. Subsequent operational deployment of the MPS will provide valuable data for numerical weather forecasting and oceanography while the accumulation over a long time period of consistent measurements of the global pressure field will contribute significantly to the data resources needed for climate studies.

FORNEY, R. G.

F026 Proceedings of the Alternate Energy Systems Seminar

M. E. Alper, R. E. Bartera, H. S. Davis,
R. G. Forney, C. F. Mohl, H. J. Stewart, and
V. C. Truscello

JPL Publication 78-45, March 30, 1978

For abstract, see Alper, M E

FRANCO, M.

F027 A Method for Measuring Group Time Delay Through a Feed Horn

T. Y. Otoshi, R. B. Lyon, and M. Franco

The Deep Space Network Progress Report 42-44
January and February 1978, pp 82-89, April 15,
1978

For abstract, see Otoshi, T Y

FRANDSEN, A. M. A.

F028 The ISEE-C Vector Helium Magnetometer

A. M. A. Frandsen, B. V. Connor,
J. Van Amersfoort, and E. J. Smith

IEEE Trans Geosci Electron, Vol GE-16, No 3,
pp 195-198, July 1978

The ISEE-C vector helium magnetometer is a slightly modified instrument that originally served as the spare unit for the Pioneer 10 and 11 missions to Jupiter. The essential features of the instrument are described and the specifications are tabulated. Scientific objectives and minor modifications needed for the ISEE mission are discussed briefly.

FREILEY, A. J.

F029 Absolute Flux Density Calibrations of Radio Sources: 2.3 GHz

A. J. Freiley, P. D. Batelaan, and D. A. Bathker

Technical Memorandum 33-806, December 1, 1977

This report is a detailed description of a NASA/JPL Deep Space Network program to improve S-band (2.3 GHz) gain calibrations of large aperture antennas. The program is considered unique in at least three ways, first, absolute gain calibrations of high quality suppressed-sidelobe dual mode horns first provide a high accuracy (± 0.04 dB or better than ± 1 percent with 3σ confidence) foundation to the program. Second, a very careful transfer calibration technique using an artificial far-field co-

herent-wave source was used to accurately (± 0.21 dB or better than $\pm 5\%$ with 3σ confidence) obtain the gain of one large (26 m) aperture. Third, using the calibrated large aperture directly, the absolute flux density of five selected galactic and extragalactic natural radio sources was determined with an absolute accuracy better than 2 percent, now quoted at the familiar 1σ confidence level. The follow-on considerations to apply these results to an operational network of ground antennas are discussed. It is concluded that absolute gain accuracies within ± 0.30 to 0.40 dB (with 3σ confidence) are possible, depending primarily on the repeatability (scatter) in the field data from Deep Space Network user stations.

This report should be of considerable interest to a wide audience, those concerned with electromagnetic standards, antenna and microwave engineers, radio astronomers, and finally those responsible for carefully evaluating, operating and maintaining ground facilities of a similar kind.

F030 Absolute Flux Density Calibrations: Receiver Saturation Effects

A. J. Freiley, J. E. Ohlson, and B. L. Seidel

The Deep Space Network Progress Report 42-46
May and June 1978, pp 123-129, August 15,
1978

The effect of receiver saturation is examined for a total power radiometer which uses an ambient load for calibration. Extension to other calibration schemes is indicated. The analysis shows that a monotonic receiver saturation characteristic could cause either positive or negative measurement errors, with polarity depending upon operating conditions. A realistic model of the receiver is made using a linear-cubic voltage transfer characteristic. The evaluation of measurement error for this model then provides a means for correcting radio source measurements. It also provides the means for assuring that this source of error is small in a particular situation.

FRENCH, J. R.

F031 New Concepts for Mercury Orbiter Missions

J. R. French, J. R. Stuart, and B. Zeldin

Preprint 78-79, AIAA Sixteenth Aerospace Sciences Meeting, Huntsville, Ala., January 16-18, 1978

The next logical step in the exploration of Mercury is an orbiter mission. A conflict exists between those in the field of planetary sciences who desire a mission with a low circular orbit, and scientists in the fields and particles disciplines, who generally prefer a highly elliptical spacecraft orbit. The thermal environment imposed by the Sun and planet render the low orbit intolerable for spacecraft using previous thermal control methods. A

thermal control concept and a spacecraft mission concept have been developed which resolve these problems and promise a scientifically significant mission for the mid-1980s

FRENCH, R. L.

F032 Solar Energy for Process Heat: Design/Cost Studies of Four Industrial Retrofit Applications

R. L. French and R. E. Bartera

JPL Publication 78-25, April 1, 1978

Five specific California plants with potentially attractive solar applications were identified in a process heat survey, conducted by JPL. These five plants were visited, process requirements evaluated, and conceptual solar system designs were generated. JPL obtained the services of A. C. Martin and Associates to make preliminary layout drawings and generate installation cost estimates for four of the plants. From the refined A. C. Martin designs, JPL conducted studies to determine expected thermal and economic performance. A cost estimate for the fifth system was made by extrapolating from data in the A. C. Martin estimates and other available DOE work. Four DOE (ERDA) sponsored solar energy system demonstration projects were also reviewed and compared to the design/cost cases included in this report.

In four of the five cases investigated, retrofit installations providing significant amounts of thermal energy were found to be feasible. The fifth was rejected because of the condition of the building involved, but the process (soap making) appears to be an attractive potential solar application. Costs, however, tend to be high ranging from 12.00 to 26.00 \$/10⁶ Btu after taxes. Several potential areas for cost reduction were identified including larger collector modules and higher duty cycles.

Prepared for the State of California Energy Resources Conservation and Development Commission

FYMAT, A. L.

F033 Analytical Inversions in Remote Sensing of Particle Size Distributions. 1: Multispectral Extinctions in the Anomalous Diffraction Approximation

A. L. Fymat

Appl. Opt., Vol. 17, No. 11, pp. 1675-1676, June 1, 1978

Consideration is given to analytical inversions in the remote sensing of particle size distributions, noting multispectral extinctions in anomalous diffraction approximation and angular and spectral scattering in diffraction approximation. A closed-form analytical inverse solution is derived in order to reconstruct the size distribution of

atmospheric aerosols. The anomalous diffraction approximation to Mie's solution is used to describe the particles. Experimental data yield the geometrical area of aerosol polydispersion. Size distribution is thus found from a set of multispectral extinction measurements.

GABRIEL, A.

G001 Preliminary Studies of Electromagnetic Sounding of Cometary Nuclei

A. Gabriel, L. Warne, S. Bednarczyk, and C. Elachi

JPL Publication 78-44, October 1, 1978

The structure of cometary nuclei is a key issue in solar system cosmogony. The internal structure of a comet could be determined with a spacecraft borne electromagnetic sounder. A dielectric profile of the comet could be produced in direct analogy with terrestrial glacier and ice sheet sounding experiments. This profile would allow the detection of a rocky core or ice layers if they exist, just as layers in the ice and the bedrock interface have been clearly observed through the Greenland ice sheet. It would also provide a gross estimate of the amount of dust in the icy region. Models for the response of the nucleus and cometary plasma to electromagnetic sounding are developed and used to derive experimental parameters. A point system design was completed. Preliminary engineering study results indicate that the sounder is well within the bounds of current space technology.

GALINDO-ISRAEL, V.

G002 Synthesis of a Laterally Displaced Cluster Feed for a Reflector Antenna With Application to Multiple Beams and Contoured Patterns

V. Galindo-Israel, S. Lee, and R. Mittra

IEEE Trans. Anten. Prop., Vol. AP-26, No. 2, pp. 220-228, March 1978

When a feed is displaced from the focus of a reflector, phase distortion results in the effective aperture distribution which in turn gives rise to secondary beam distortion. In multiple beam or contour beam antennas, the feed normally consists of an array of identical elements located on a triangular lattice. Taking advantage of this arrangement a "cluster" of feed elements instead of a single element may be used to control each beam. By adjusting the relative excitations of the elements in a cluster, the aperture phase distortion due to the feed displacement may be partially compensated. Two general methods for synthesizing the excitations for a laterally displaced feed cluster are presented. In the first method the excitations are chosen to minimize the weighted phase error in the effective aperture by analytical means.

The second method determines the excitations by a gradient optimization algorithm which minimizes the weighted error between an objective and the actual power patterns in the secondary pattern space. The first method is roughly two orders of magnitude more efficient computationally than the gradient optimization algorithm, but not as flexible in application or as precise. Numerical results are presented for cluster feed designs and their application to the synthesis of contour patterns.

GALLAGHER, J. F.

G003 Multilaterating the GEOS-3 Satellite

P. R. Escobal, J. F. Gallagher (Computer Sciences Corporation), and O. H. von Roos

J. Astronaut. Sci., Vol XXV, No 3, pp 227-249, July-September, 1977

For abstract, see Escobal, P. R.

GALVEZ, J.

G004 S-Band Maser Phase Delay Stability Tests

J. M. Urech, F. Alcazar, J. Galvez, A. Rius, and C. A. Greenhall

The Deep Space Network Progress Report 42-48
September and October 1978, pp 102-117,
December 15, 1978

For abstract, see Urech, J. M.

GAMMELL, P. M.

G005 Final Report: Tissue Identification by Ultrasound

D. H. LeCrossette, R. C. Heyser,
P. M. Gammell, and R. L. Wilson (Harbor General
Hospital, Los Angeles, California)

JPL Publication 78-90, October 15, 1978

For abstract, see LeCrossette, D. H.

GANGULI, P. S.

G006 Coal Desulfurization by Low-Temperature Chlorinolysis

G. C. Hsu, J. J. Kalvinskas, P. S. Ganguli, and
G. R. Gavalas (California Institute of Technology)

Coal Desulfurization, ACS Symposium Series, No
64, American Chemical Society, Wash., D. C.,
1977, pp 206-217

For abstract, see Hsu, G. C.

GARBA, J. A.

G007 Summary of Voyager Design and Flight Loads

J. C. Chen, J. A. Garba, and F. D. Day III

JPL Publication 78-74, September 1, 1978

For abstract, see Chen, J. C.

G008 Parametric Study of Two Planar High Power Flexible Solar Array Concepts

J. A. Garba, D. A. Kudiya, B. Zeldin, and
E. N. Costogoe

JPL Publication 78-95, December 15, 1978

A parametric study to evaluate the effects of mechanical design parameters on the power-to-mass ratio for two high power flexible solar array concepts has been performed. The approach was to perturb the existing design concepts of the 66-W/kg foldout array concept developed by the Lockheed Missiles and Space Company and the 200-W/kg rollout array concept under development at the General Electric Space Division and to examine the effects of key mechanical parameters over a wide range of power levels.

The mechanical design parameters of the solar array examined in this study were frequency, aspect ratio, packaging constraints, and array blanket flatness.

Specific power-to-mass ratios for both solar arrays as a function of array frequency and array width have been developed and plotted. The data plots and computer programs developed can be used as a guide and form a design manual for future solar array designs.

The main body of this report contains summaries of the baseline design data, developed equations, the computer program operation, plots of the parameters, and the process for using the information as a design manual. The appendices contain details of the derivations of the parametric equations and computer output for selected power levels.

G009 Launch Vehicle Payload Interface Response

J. C. Chen, B. K. Wada, and J. A. Garba

J. Spacecraft Rockets, Vol 15, No 1, pp 7-11,
January-February 1978

For abstract, see Chen, J. C.

GARCIA, E. A.

G010 Network Operations Control Center Block III Modifications

E. A. Garcia

The Deep Space Network Progress Report 42-43
November and December 1977, pp 185-196,
February 15, 1978

This article provides information regarding changes to the Block III Network Operations Control Center hardware and software implemented to support Voyager and Pioneer Venus Projects and the upgrading of the Deep Space Stations to the Mark III Data Subsystems Configuration.

GATES, W. R.

G011 Historical Evidence of Importance to the Industrialization of Flat-Plate Silicon Photovoltaic Systems' Executive Summary

J. L. Smith, W. R. Gates, and T. Lee

JPL Publication 78-36, Vol I, April 1978

For abstract, see Smith, J L

G012 Historical Evidence of Importance to the Industrialization of Flat-Plate Silicon Photovoltaic Systems

J. L. Smith, W. R. Gates, and T. Lee

JPL Publication 78-36, Vol II, April 1978

For abstract, see Smith, J L.

GAUTHIER, M. K.

G013 SEM Analysis of Ionizing Radiation Effects in Linear Integrated Circuits

A. G. Stanley and M. K. Gauthier

IEEE Trans Nucl Sci, Vol NS-24, No 6, pp 2060-2065, December 1977

For abstract, see Stanley, A. G

GAVALAS, G. R.

G014 Coal Desulfurization by Low-Temperature Chlorinolysis

G. C. Hsu, J. J. Kalvinskas, P. S. Ganguli, and G. R. Gavalas (California Institute of Technology)

Coal Desulfurization, ACS Symposium Series, No 64, American Chemical Society, Wash, D C, 1977, pp 206-217

For abstract, see Hsu, G C

GELLER, M.

G015 The Rotational Spectrum and Molecular Parameters of ClO in the $v = 0$ and $v = 1$ States

R. K. Kakar, E A. Cohen, and M. Geller

J Mol Spectros, Vol 70, pp 243-256, 1978

For abstract, see Kakar, R. K

GILLETTE, R. L.

G016 Viking Extended Mission Support

R. L. Gillette

The Deep Space Network Progress Report 42-45
March and April 1978, pp 4-6, June 15, 1978

This report covers the period from 1 January through 31 February 1978 It reports on DSN support of Viking spacecraft activities during the period and continues reporting on the DSN Viking Command and Tracking support It also continues the reports on the status of DSN Mark III Data (MDS) Subsystem Implementation Project related Viking testing

G017 Viking Extended Mission Support

R. L. Gillette

The Deep Space Network Progress Report 42-46
May and June 1978, pp 29-32, August 15, 1978

This report covers the period from 1 March through 30 April 1978 It reports on DSN support of Viking spacecraft activities during the period and continues reporting on the DSN Viking Command and Tracking support It also continues the reports on the status of Viking DSN Mark III Data Subsystem Implementation Project (MDS) related testing

G018 Viking Extended Mission Support

R. L. Gillette

The Deep Space Network Progress Report 42-47
July and August 1978, pp 15-20, October 15, 1978

This article covers the period from May 1 through June 30, 1978 It reports on DSN support of Viking spacecraft activities during the period and continues reporting on the DSN Viking Command and Tracking support

G019 Viking Continuation Mission Support

R. L. Gillette

The Deep Space Network Progress Report 42-48
September and October 1978, pp 7-11,
December 15, 1978

This article covers the period from 1 July through 31 August 1978. It reports on DSN support of Viking Spacecraft activities during the period and continues reporting on the DSN Viking Command and Tracking support.

GLUCKLICH, J.

G020 Strain Energy Function of Styrene Butadiene Rubber and the Effect of Temperature

J. Glucklich and R. F. Landel

J Polym Sci Polym Phys, Vol 15, No. 12, pp 2185-2199, December 1977

Biaxial and uniaxial tensile stress relaxation tests were made on square sheet specimens of styrene butadiene rubber (SBR), mounted in a universal biaxial tester within a temperature-controlled box, with the object of studying the effect of temperature on the strain energy function. The stress relaxation responses, usually for times up to 10 min, were obtained for various degrees of biaxiality, various extension ratios, and various temperatures within the limits of +25 to -45°C. The results indicated that if the Valanis-Landel representation of the strain energy function $W = \sum_{i=1}^3 w(\lambda_i)$ is adopted, then time and strain are factorizable over the indicated temperature range, with time and temperature being related in the usual fashion. That is, changing the temperature does not affect the form of $w(\lambda_i)$ but only that of $G(t/a_T)$, the temperature-dependent relaxation modulus, a_T being the regular Williams-Landel-Ferry (WLF) shift factor. The results verify the Valanis-Landel theory for various combinations of biaxiality.

GOETZ, A. F. H.

G021 A Study of Alteration Associated With Uranium Occurrences in Sandstone and Its Detection by Remote Sensing Methods

J. E. Conel, M. J. Abrams, and A. F. H. Goetz

JPL Publication 78-66, Vols I and II, August 1, 1978

For abstract, see Conel, J. E.

GOLD, R. E.

G022 The Energetic Particle Environment of the Solar Probe Mission—As Estimated by the Participants in the Solar Probe Environment Workshop

M. Neugebauer, L. A. Fisk, R. E. Gold, R. P. Lin, G. Newkirk, J. A. Simpson, and M. A. I. Van Hollebeke

JPL Publication 78-64, September 1, 1978

For abstract, see Neugebauer, M.

GOLDBERG, B. A.

G023 Images of Io's Sodium Cloud

D. L. Matson, B. A. Goldberg, T. V. Johnson, and R. W. Carlson

Science, Vol 199, pp 531-533, February 3, 1978

For abstract, see Matson, D. L.

GOLDSTEIN, R.

G024 Fiber Optic Rotation Sensor (FORS) Signal Detection and Processing

W. C. Goss and R. Goldstein

Proc SPIE, Vol 139, pp 76-87, 1978

For abstract, see Goss, W. C.

GOODWIN, P. S.

G025 Helios Mission Support

P. S. Goodwin and G. M. Rockwell

The Deep Space Network Progress Report 42-43
November and December 1977, pp 24-28,
February 15, 1978

This article reports on activities of the Network Operations organization in support of the Helios Project from 15 October 1977 through 15 December 1977.

G026 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and G. M. Rockwell

The Deep Space Network Progress Report 42-44
January and February 1978, pp 50-53, April 15, 1978

This article reports on activities of the DSN Network Operations Organization in support of the Helios Project from 15 December 1977 through 15 February 1978.

G027 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and G. M. Rockwell

The Deep Space Network Progress Report 42-45
March and April 1978, pp 101-103, June 15,
1978

This article reports on activities of the DSN Network Operations Organization in support of the Helios Project from February 15, 1978 through April 15, 1978

G028 Helios Mission Support

P. S. Goodwin, G. M. Rockwell, and
W. N. Jensen

The Deep Space Network Progress Report 42-46
May and June 1978, pp 37-39, August 15, 1978

This article reports on activities of the DSN Network Operations organization in support of the Helios Project from 15 April 1978 through 15 June 1978

G029 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and
G. M. Rockwell

The Deep Space Network Progress Report 42-47
July and August 1978, pp 26-28, October 15,
1978

This article reports on activities of the DSN Network Operations organization in support of the Helios Project from 15 June through 15 August 1978

G030 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and
G. M. Rockwell

The Deep Space Network Progress Report 42-48
September and October 1978, pp 15-17,
December 15, 1978

This article reports on activities of the DSN Network Operations Organization in support of the Helios Project from 15 August 1978 through 15 October 1978

GOSS, W.

G031 Wide Area Detection System: Conceptual Design Study

E. E. Hilbert, C. Carl, W. Goss, G. R. Hansen,
M. J. Olsasky, and A. R. Johnston

JPL Publication 78-32, February 1978

For abstract, see Hilbert, E. E.

GOSS, W. C.

G032 Fiber Optic Rotation Sensor (FORS) Signal Detection and Processing

W. C. Goss and R. Goldstein

Proc SPIE, Vol 139, pp 76-87, 1978

The recent development of low loss single mode optical fiber waveguides for light has made possible a new class of inertial reference devices built on the principle of a closed loop interferometer. Light circulating through the loop in both directions experiences a relative phase delay proportional to rotation rate about the loop axis. This paper derives the phase delay and discusses signal detection, signal processing techniques and error sources. It is concluded that synchronous modulation and demodulation and an active gain control at the signal calculation level are required to eliminate drift errors. Potential performance is extraordinarily good, rotation rate sensitivity of a few milli-arc seconds per second and angular position random walk errors of an arc second per square root hour appear feasible.

GREEN, W.

G033 Processing the Viking Lander Camera Data

E. C. Levinthal (Stanford University), W. Green,
K. L. Jones (Brown University), and
R. Tucker (Stanford University)

J Geophys Res, Vol 82, No 28, pp 4412-4420
September 30, 1977

For abstract, see Levinthal, E. C.

GREEN, W. B.

G034 Viking Image Processing

W. B. Green

Proc SPIE, Vol 119, pp 2-9, 1977

The Viking Orbiter and Viking Lander spacecraft have thus far returned several thousand images of Mars from orbit and from the surface. The Orbiter spacecraft are equipped with vidicon systems and the Lander spacecraft utilize facsimile cameras with photosensitive diode arrays. JPL's Image Processing Laboratory processed both Orbiter and Lander imagery in support of mission operations and science analysis. Digital processing included enhancement, geometric projection for a variety of applications, and mosaicking. The Orbiter cameras obtained stereo views of portions of the Martian surface by viewing the same portion of the surface at different viewing angles as the spacecraft passed overhead. Orbiter stereo imagery was processed to produce elevation maps of large portions of the surface. Each Lander spacecraft had two cameras positioned approximately one meter apart that provided stereo coverage of a portion of the field of view around each Lander spacecraft. Lander stereo imagery was processed to produce elevation profiles and

isoelevation contours of the surface surrounding each Lander

GREENBERGER, H.

G035 An Iterative Algorithm for Decoding Block Codes Transmitted Over a Memoryless Channel

H. Greenberger

The Deep Space Network Progress Report 42-47
July and August 1978, pp 51-59, October 15, 1978

An algorithm has been developed which optimally decodes a block code for minimum probability of symbol error in an iterative manner. The initial estimate is made by looking at each bit independently and is improved by considering bits related to it through the parity check equations. The dependent bits are considered in order of increasing probability of error. Since the computation proceeds in a systematic way with the bits having the greatest effect being used first, the algorithm approaches the optimum estimate after only a fraction of the parity check equations have been used. This decoding algorithm will be tested via simulations of the (128, 64, 22) BCH code over the deep space channel.

GREENHALL, C. A.

G036 Examination of the DSN X-Band Weather Specifications

C. A. Greenhall

The Deep Space Network Progress Report 42-45
March and April 1978, pp 197-208, June 15, 1978

Effects of weather on DSN system performance at X-band are examined by comparing a record of 64-meter system noise temperatures with weather observations taken at approximately the same times and places.

G037 S-Band Maser Phase Delay Stability Tests

J. M. Urech, F. Alcazar, J. Galvez, A. Rius, and C. A. Greenhall

The Deep Space Network Progress Report 42-48
September and October 1978, pp 102-117, December 15, 1978

For abstract, see Urech, J. M.

GRIFFITH, J.

G038 Environmental Testing of Flat Plate Solar Cell Modules

J. Griffith, L. Dumas, and A. Hoffman

Proc. Seminar on Testing Solar Energy Mater. Syst., Washington, D.C., May 1978, pp 1-11

The Low-Cost Solar Array (LSA) Project at the Jet Propulsion Laboratory has as one objective the development and implementation of environmental tests for solar cell modules as part of the Department of Energy's terrestrial photovoltaic program. Modules procured under this program have been subjected to a variety of laboratory tests intended to simulate service environments, and the results of these tests have been compared to available data from actual field service. This comparison indicates that certain tests (notably temperature cycling, humidity and cyclic pressure loading) are effective indicators of some forms of field failures. Other tests have yielded results useful in formulating module design guidelines. Not all effects noted in field service have been successfully reproduced in the laboratory, however, and work is continuing to improve the value of the test program as a tool for evaluating module design and workmanship. This paper contains a review of these ongoing efforts, an outline of plans for upgrading the test program, and an assessment of significant test results to date.

GROSSI, M.

G039 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography: Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle, E. Christensen, D. Farless, J. Mehta, B. Seidel, W. Michael, Jr. (Langley Research Center), A. Wallio (Langley Research Center), and M. Grossi (Raytheon Company)

J. Geophys. Res., Vol 82, No 28, pp 4317-4324, September 30, 1977

For abstract, see Fjeldbo, G.

GULKIS, S.

G040 Evidence for the Depletion of Ammonia in the Uranus Atmosphere

S. Gulkis, M. A. Janssen, and E. T. Olsen

Icarus, Vol 34, No 1, pp 10-19, April 1978

The theoretical disk brightness temperature spectra for Uranus are computed and compared with the observed microwave spectrum. It is shown that the emission observed at short centimeter wavelengths originates deep below the region where ammonia would ordinarily begin to condense. We demonstrate that this result is inconsistent with a wide range of atmospheric models in which the partial pressure of NH_3 is given by the vapor-pres-

sure equation in the upper atmosphere. It is estimated that the ammonia mixing ratio must be less than 10^{-6} in the 150 to 200 K temperature range. This is two orders of magnitude less than the expected mixing ratio based on solar abundances. The evidence for this depletion and a possible explanation are discussed.

G041 Jupiter's Atmosphere: Observations and Interpretation of the Microwave Spectrum Near 1.25-cm Wavelength

M. J. Klein and S. Gulkis

Icarus, Vol 35, pp 44-60, 1978

For abstract, see Klein, M J

G042 Extraterrestrial Intelligence: An Observational Approach

B. C. Murray S. Gulkis, and R. E. Edelson

Science, Vol 199, pp 485-492, February 3, 1978

For abstract, see Murray, B C

GUPTA, A.

G043 Photoacoustic Spectroscopy of Organometallic Compounds With Applications in the Fields of Quasi-One-Dimensional Conductors and Catalysis

R. B. Somoano, A. Gupta, W. Volksen, A. Rembaum, and R. Williams (California Institute of Technology)

Organometallic Polymers, pp 165-174, Academic Press, Inc., New York, N Y, 1978

For abstract, see Somoano, R. B

GURFIELD, R. M.

G044 Potential for Cogeneration of Heat and Electricity in California Industry—Phase I. Final Report

H S. Davis, R. M. Gurfield, V. C. Moretti, and M. L. Slonski

JPL Publication 78-42, May 1, 1978

For abstract, see Davis, H S

HADEK, V.

H001 Optical, Spin-Resonance, and Magnetoresistance Studies of (Tetrathiatetracene)₂(Iodide)₃. The Nature of the Ground State

R. B. Somoano, S. P. S. Yen, V. Hadek, S. K. Khanna, M. Novotny (Stanford University), T. Datta (Tulane University), A. M. Hermann (Tulane University), and J. A. Woollam (Lewis Research Center)

Phys Rev, Pt B Solid State, Vol 17, No 7, pp 2853-2857, April 1, 1978

For abstract, see Somoano, R. B

H002 Electrical Properties of (DEPE) (TCNQ)₄

R. B. Somoano, V. Hadek, S. P. S. Yen, A. Rembaum, C. H. Hsu (California Institute of Technology), R. J. Deck (Tulane University), T. Datta (Tulane University), and A. M. Hermann (Tulane University)

Phys Stat Sol (B), Vol 81, No 1, pp 281-286, 1977

For abstract, see Somoano, R. B

HAGAN, M.

H003 Compatibility Studies of Various Refractory Materials in Contact with Molten Silicon

T. O'Donnell, M. Leipold, and M. Hagan

JPL Publication 78-18, March 1, 1978

For abstract, see O'Donnell, T

HAINES, E. L.

H004 Thorium Concentrations in the Lunar Surface. I: Regional Values and Crustal Content

A. E. Metzger, E. L. Haines, R. E. Parker, and R. G. Radocinski

Proc Eighth Lunar Sci Conf Houston, Tex, March 14-18, 1977, pp 949-999

For abstract, see Metzger, A E

HALBERSTAM, I. M.

H005 A study of Forecast Error Growth With a Barotropic Model of the Atmosphere

I. M. Halberstam

JPL Publication 78-3, April 1, 1978

A barotropic model of the atmosphere is used to test various sources of forecast error. These errors are classified as truncation error, physical error, or initial error. It is shown that growth patterns due to each category differ significantly. Initial errors are shown not to grow in a

barotropic model contrary to reports of other studies which indicate that they basically do grow. Also, random initial errors are shown to decrease due to the filtering effect of the model itself. Results seem to indicate that instabilities are required for error growth, be they barotropic or baroclinic, and that random errors are not representative of true initial conditions

HALL, R. A.

H006 Evaluation of FIDC System: Final Report

R. A. Hall, M. W. Dowdy, and T. W. Price

JPL Publication 78-93, October 15, 1978

A fuel vapor injector/igniter system developed by the Fuel Injection Development Corporation has been evaluated for its effect on vehicle engine performance, fuel economy, and exhaust emissions. Initially, a single cylinder engine was operated with the vapor injector/igniter and improved combustion was inferred from the leaner operation achieved with the vapor injector/igniter. However, the improved fuel economy and emissions found during the single cylinder tests were not realized with the multicylinder engine. Multicylinder engine tests were conducted to compare the FIDC system with both a stock and a modified stock configuration. A comparison of cylinder-to-cylinder equivalence ratio distribution was also obtained from the multicylinder engine tests. Finally, the multicylinder engine was installed in a vehicle, and the vehicle was tested on a chassis dynamometer to compare the FIDC system with stock and modified stock configurations. The FIDC configuration demonstrated approximately five percent improved fuel economy over the stock configuration, but the modified stock configuration demonstrated approximately twelve percent improved fuel economy.

The hydrocarbon emissions were approximately two-hundred-thirty percent higher with the FIDC system than with the stock configuration. Both the FIDC system and the modified stock configuration adversely affected driveability. In the final analysis, the FIDC system demonstrated a modest fuel savings, but with the penalty of increased emissions, and loss of driveability.

HAMILTON, C. L.

H007 The Engineering Analysis of Solar Radiation

M. S. Reid, C. L. Hamilton, and O. V. Hester

Policy Anal Inform Syst, Knowledge Systems Laboratory, University of Illinois at Chicago, pp 187-217, 1978

For abstract, see Reid, M S

HANSEN, G. R.

H008 Fully Automated Urban Traffic System

B. M. Dobrotin, T. K. C. Peng,
G. R. Hansen, and D. A. Rennels

JPL Publication 77-64, December 1977

For abstract, see Dobrotin, B M

H009 Wide Area Detection System: Conceptual Design Study

E. E. Hilbert, C. Carl, W. Goss, G. R. Hansen,
M. J. Olsasky, and A. R. Johnston

JPL Publication 78-32, February 1978

For abstract, see Hilbert, E E

H010 A Distributed Microprocessor System for Topographic Imaging of the Ocean Floor

G. R. Hansen

Preprint, Microprocessor Applications in NASA, Session 14, Electro/78 Electron Show and Conv, Boston, Mass, May 23-25, 1978

Oceanographic instrumentation systems are akin to spacecraft systems in that a variety of instruments exist to measure different phenomena. The complexities of specialized spacecraft hardware have led to the development of a microprocessor-based Unified Data System (UDS) that provides a common instrument interface while accommodating the command and control idiosyncrasies of individual instruments. This paper describes the adaptation of the UDS concept to oceanographic use, and particularly to the gathering of acoustic imaging data by the Advanced Ocean Technology Development Platform.

HARTOP, R.

H011 New X-Band Microwave Equipment at the DSN 64-Meter Stations

R. Hartop

The Deep Space Network Progress Report 42-48
September and October 1978, pp 126-128,
December 15, 1978

In order to improve the performance and capabilities of the DSN 64-m antennas at X-band, extensive modifications to the XRO cone assemblies are in process. The changes include a new feed assembly with a dual hybrid mode horn and orthogonal mode junction, dual traveling wave masers, and a new receiver mode selector.

HARTOP, R. W.

H012 Dual-Frequency Feed Cone Assemblies for 34-Meter Antennas

R. W. Hartop

The Deep Space Network Progress Report 42-47 July and August 1978, pp 85-88, October 15, 1978

New Cassegrain cone assemblies have been designed for the upgrade of three 26-meter-diameter antennas to 34-meter diameter with improved performance. The new dual-frequency feed cone (SXD) provides both S- and X-band feed systems and traveling wave masers with a reflex reflector system to permit simultaneous operation analogous to the 64-meter antennas. One cone assembly has been completed and two more are in fabrication, with deliveries set for early and midyear 1979.

HARVEY, S.

H013 Synthesis and Biological Screening of Novel Hybrid Fluorocarbon Hydrocarbon Compounds for Use as Artificial Blood Substitutes—Annual Report, July 1976–July 1977

J. Moacanin, K. Scherer, A. Toronto (Utah Biological Test Laboratory), D. Lawson, T. Terranova, L. Astle (Utah Biological Test Laboratory), and S. Harvey (Utah Biological Test Laboratory)

JPL Publication 77-80, January 15, 1978

For abstract, see Moacanin, J

HAVENS, W. F.

H014 Attitude Determination System for a Nadir-Pointing Satellite

W. F. Havens and H. Ohtakay

J Guidance Contr, Vol 1, No 5, pp 352-358, September–October 1978

An attitude determination system for a nadir-pointing satellite with a high inclination orbit is investigated. The major engineering difficulty of such a system lies in estimating the nadir direction due primarily to large uncertainties of Earth atmospheric conditions caused by seasonal and diurnal variations over a wide range of latitude. Presented in this paper are investigation results of an attitude determination system approach which automatically adapts itself to those variations and augments the end-to-end attitude determination accuracy of science-sensor boresights through in-flight calibration. The engineering approaches discussed in this paper will be applied to the SEASAT-A mission.

HEER, E.

H015 The Role of Robots and Automation in Space

E. Heer

JPL Publication 78-78, September 1, 1978

Advanced space transportation systems based on the Shuttle and Interim Upper Stage will open the way to the use of large-scale industrial and commercial systems in space. The role of robot and automation technology in the cost-effective implementation and operation of such systems in the next two decades is discussed. Planning studies initiated by NASA are described as applied to space exploration, global services, and space industrialization, and a forecast of potential missions in each category is presented. The Appendix lists highlights of space robot technology from 1967 to the present.

HEFT, R.

H016 Automotive Technology Status and Projections: Executive Summary

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol I, June 1978

For abstract, see Dowdy, M

H017 Automotive Technology Status and Projections: Assessment Report

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol II, June 1978

For abstract, see Dowdy, M

HEGLER, R., JR.

H018 Storage, Transmission and Distribution of Hydrogen

J. H. Kelley and R. Hegler, Jr.

Hydrogen Energy System Proc Second World Hydrogen Energy Conf, Zurich, Switzerland, August 21-24, 1978, pp 25-53, Pergamon Press, New York, N.Y., 1978

For abstract, see Kelley, J H

HEIMBURGER, D. A.

H019 A Survey of Electric and Hybrid Vehicle Simulation Programs: Final Report

J. Bevan, D. A. Heimbürger, and M. A. Metcalfe

JPL Publication 78-58, Vol I, July 1, 1978

For abstract, see Bevan, J

HELLINGS, R. W.

**H020 Testing Relativistic Theories of Gravity With
Spacecraft-Doppler Gravity-Wave Detection**

R. W. Hellings

Phys Rev, Pt D Part Fields, Vol 17, No 12, pp
3158-3163, June 15, 1978

The response of a spacecraft Doppler-tracking system to the passage of a weak plane gravity wave of the most general polarization is calculated. Results show that the simultaneous tracking of several spacecraft could provide an unambiguous determination of the gravity-wave polarization, a much needed result in the continuing experimental testing of relativistic theories of gravity

HERMANN, A. M.

**H021 Optical, Spin-Resonance, and Magnetoresistance
Studies of $(\text{Tetrathiatetracene})_2(\text{Iodide})_3$. The Nature
of the Ground State**

R. B. Somoano, S. P. S. Yen, V. Hadek,
S. K. Khanna, M. Novotny (Stanford University),
T. Datta (Tulane University),
A. M. Hermann (Tulane University), and
J. A. Woollam (Lewis Research Center)

Phys Rev, Pt B Solid State, Vol 17, No 7, pp
2853-2857, April 1, 1978

For abstract, see Somoano, R. B

H022 Electrical Properties of (DEPE) $(\text{TCNQ})_4$

R. B. Somoano, V. Hadek, S. P. S. Yen,
A. Rembaum, C. H. Hsu (California Institute of
Technology), R. J. Deck (Tulane University),
T. Datta (Tulane University), and
A. M. Hermann (Tulane University)

Phys Stat Sol (B), Vol 81, No 1, pp 281-286,
1977

For abstract, see Somoano, R. B

H023 On the Crystal Phases of (DEPE) $(\text{TCNQ})_4$

L. B. Coleman (University of California, Davis),
A. M. Hermann (Tulane University),
R. Williams (California Institute of Technology),
and R. B. Somoano

Phys Stat Sol (B), Vol 82, No 2, pp K117-
K121, 1977

For abstract, see Coleman, L. B

HESTER, O. V.

**H024 A Probabilistic Model of Insolation for the Mojave
Desert Area**

O. V. Hester and M. S. Reid

JPL Publication 78-11, March 1, 1978

This report presents a discussion of mathematical models of insolation characteristics suitable for use in analysis of solar energy systems and shows why such models are essential for solar energy system design. A model of solar radiation for the Mojave Desert area is presented with probabilistic and deterministic components which reflect the occurrence and density of clouds and haze, and mimic their effects on both direct and indirect radiation. The model has the capability of producing any or all of the following outputs: (1) a "clear sky" theoretical amount of solar radiation, (2) solar radiation for a clear sky or a cloudy sky or for a sky partially clear and partially cloudy depending on certain probabilistic parameters, (3) an array of average solar energy reception rates (solar intensities) in kilowatts per square meter (kW/m^2) for a specified length of time

Multiple comparisons were made between measured total energy received per day and the corresponding simulated totals. The simulated totals were all within 11% of the measured total. The conclusion is that a useful probabilistic model of solar radiation for the Goldstone, California, area of the Mojave Desert has been constructed

H025 The Engineering Analysis of Solar Radiation

M. S. Reid, C. L. Hamilton, and O. V. Hester

Policy Anal Inform Syst, Knowledge Systems
Laboratory, University of Illinois at Chicago,
pp 187-217, 1978

For abstract, see Reid, M. S

HEYSER, R. C.

H026 Final Report: Tissue Identification by Ultrasound

D. H. LeCrossette, R. C. Heyser,
P. M. Gammell, and R. L. Wilson (Harbor General
Hospital, Los Angeles, California)

JPL Publication 78-90, October 15, 1978

For abstract, see LeCrossette, D. H

HIBBS, A. R.

H027 An Entree for Large Space Antennas

R. V. Powell and A. R. Hibbs

Astronaut Aeronaut, Vol 15, No 12, pp 58-64,
December 1977

For abstract, see Powell, R V

HIETZKE, W. H.

H028 A New, Nearly Free, Clock Synchronization Technique

W. H. Hietzke

The Deep Space Network Progress Report 42-44
January and February 1978, pp 268-272,
April 15, 1978

A new, near real-time, method for intercomplex clock synchronization is proposed. The method consists of transmitting a symmetric frequency ramp to a spacecraft and determining the time at which the received ramp (in doppler residuals) occurs at overlapping stations. Adjusted preliminary data suggest that the accuracy of the method may be better than 0.7 microseconds. The method requires no additional hardware and can be done during normal tracks. Other, perhaps more accurate, variations of the method are under investigation.

HIGGINS, S.

H029 Energy Consumption Program—A Computer Model Simulating Energy Loads in Buildings

F. W. Stoller, F. L. Lansing, V. W. Chai, and
S. Higgins

The Deep Space Network Progress Report 42-45
March and April 1978, pp 288-293, June 15,
1978

For abstract, see Stoller, F W

HIGGINS, S. N.

H030 JPL Energy Consumption Program (ECP) Documentation: A Computer Model Simulating Heating, Cooling and Energy Loads in Buildings

F. L. Lansing, V. W. Chai, S. N. Higgins,
D. Lasco, R. Urbanajo, and P. Wong

JPL Publication 78-76, September 15, 1978

For abstract, see Lansing, F L.

HILBERT, E. E.

H031 Wide Area Detection System: Conceptual Design Study

E. E. Hilbert, C. Carl, W. Goss, G. R. Hansen,
M. J. Olsasky, and A. R. Johnston

JPL Publication 78-32, February 1978

The objective of the Wide Area Detection System (WADS) Project is to determine the technical feasibility of using state of the art imaging (such as television) and processor (such as microprocessor) technology to build an integrated sensor for traffic surveillance on mainline sections of urban freeways. This sensor would be capable of automatically making "area" measurements, i.e. across several lanes as well as along the traffic stream in each lane. These measurements, such as lane density, speed, and volume, would be transmitted back to the central control facility by conventional means and a set of WADS sensors would thus be deployed to cover the entire length of the freeway. The freeway image would also be used for surveillance and incident diagnosis. The WADS project consists of two phases: first, a conceptual design study and second, building a "breadboard" operating sensor.

This volume documents the results of the study phase. This includes 1) the functional requirements for the sensor, 2) the survey of applicable imaging and processor technology, and 3) the conceptual design of the breadboard sensor.

Prepared for the U.S. Department of Transportation,
Report No. FHWA-RD-77-86

HILDEBRAND, C. E.

H032 The Mass of Phobos From Viking Flybys

E. J. Christensen, G. H. Born,
C. E. Hildebrand, and B. G. Williams

Geophys Res Lett, Vol 4, No 12, pp 555-557,
December 1977

For abstract, see Christensen, E J

HILT, D. E.

H033 Δ VLBI Spacecraft Tracking System Demonstration: Part I. Design and Planning

D. L. Brunn, R. A. Preston, S. C. Wu,
H. L. Siegel, D. S. Brown, C. S. Christensen, and
D. E. Hilt

The Deep Space Network Progress Report 42-45
March and April 1978, pp 111-132, June 15,
1978

For abstract, see Brunn, D L.

HINKLEY, E. D.

**H034 Bandstrength Determination of the Fundamental
Vibration-Rotation Spectrum of CIO**

J. S. Margolis, R. T. Menzies, and E. D. Hinkley

Appl Opt, Vol 17, No. 11, pp 1680-1682,
June 1, 1978

For abstract, see Margolis, J S

HINTZ, G. R.

**H035 Orbit Trim Maneuver Design and Implementation
for the 1975 Mars Viking Mission**

G. R. Hintz, D. L. Farless, and M. J. Adams

Preprint 78-1394, AIAA/AAS Astrodyn Conf, Palo
Alto, Calif, August 7-9, 1978

Viking was the first United States project to send soft-landers to the surface of another planet. Each spacecraft consisted of an orbiter with an attached lander. Propulsive maneuver strategies and operational techniques were developed for the orbiters to accommodate real-time landing site targeting adjustments, to satisfy intermediate reconnaissance and lander-separation orbit control requirements, to maintain the lander-to-orbiter radio relay geometry, and to meet orbiter science objectives. The maneuver strategy design process included the selection of target parameters and the minimization of both propellant usage and the effects of execution errors, while complying with mission and operational constraints.

HIRSHBERG, A. S.

**H036 A Southern California Gas Company Project SAGE
Report—Public Policy Issues**

A. S. Hirshberg

JPL Publication 77-47, January 1978

This report recognizes that use of solar energy to stretch our supplies of fossil fuels is to this Nation's benefit. Project SAGE, sponsored in part by the Southern California Gas Company, addresses itself to one application of this goal: solar assistance in central water heating systems for multifamily projects.

Public policy issues that can affect the rate of adoption of solar energy systems are investigated and policy ac-

tions are offered to accelerate the adoption of SAGE and other solar energy systems.

Prepared for the Southern California Gas Company

**H037 A Southern California Gas Company Project SAGE
Report—Utilization Requirements**

R. Schoen (University of California, Los Angeles)
and A. S. Hirshberg

JPL Publication 77-49, January 1978

For abstract, see Schoen, R.

**H038 The Diffusion of the Use of New Energy
Technology as a Context for an Overview of Solar
Energy Technologies**

A. S. Hirshberg

JPL Publication 77-76, March 1977

The process by which new solutions to the energy dilemma are generated and used as a context for an overview of solar energy economics and technologies is summarized in this report.

**H039 An Overview of U.S. Energy Options: Supply-and-
Demand-Side History and Prospects**

A. S. Hirshberg

JPL Publication 77-77, February 25, 1977

This report provides an overview of nonsolar energy policy options available to the United States until solar energy conversion and utilization devices can produce power at a cost competitive with that obtained from fossil fuels. The economics of the development of new fossil fuel sources and of mandatory conservation measures in energy usage are clarified in the context of the historic annual rate of increase in U.S. energy demand. An attempt is made to compare the costs and relative efficiencies of energy obtainable from various sources by correlating the many confusing measurement units in current use.

HLAVKA, G. E.

**H040 Process Heat in California: Applications and
Potential for Solar Energy in the Industrial,
Agricultural and Commercial Sectors**

R. H. Barbieri, R. E. Bartera, E. S. Davis,
G. E. Hlavka, D. S. Pivrotto, and G. Yanow

JPL Publication 78-33, March 1978

For abstract, see Barbieri, R. H.

HOFFMAN, A.

H041 Environmental Testing of Flat Plate Solar Cell Modules

J. Griffith, L. Dumas, and A. Hoffman

Proc Seminar on Testing Solar Energy Mater Syst, Washington, D C, May 1978, pp 1-11

For abstract, see Griffith, J

HOLBECK, H. J.

H042 Siting Issues for Solar Thermal Power Plants With Small Community Applications

H. J. Holbeck and S. J. Ireland

JPL Publication 78-75, July 20, 1978

Technologies for solar thermal plants are being developed to provide energy alternatives for the future. Implementation of these plants requires consideration of siting issues as well as power system technology. While many conventional siting considerations are applicable, there is also a set of unique siting issues for solar thermal plants. Early experimental plants will have special siting considerations.

This report considers the siting issues associated with small, dispersed solar thermal power plants in the 1- to 10-MWe power range for utility/small community applications. Some specific requirements refer to the first 1-MWe engineering experiment for the Small Power Systems applications (SPSA) Project.

The first two sections of the report provide background for the subsequent issue discussions. The introductory section describes the SPSA Project and the requirements for the first engineering experiment and gives the objectives and scope for the report as a whole. A brief overview of solar thermal technologies is followed by a discussion of some technology options.

The siting issues themselves are discussed in the remainder of the report in three categories: (1) system resource requirements, (2) environmental effects on the system, and (3) potential impact of the plant on the environment. Within these categories, specific issues are discussed in a qualitative manner. Examples of limiting factors for some issues are taken from studies of other solar systems. Important siting issues are summarized in the last section of the report.

Prepared for the Department of Energy, DOE/JPL-1060-78/2, Distribution Category UC-62

HOLLAND, A. L.

H043 Mars' Water Vapor Observations From the Viking Orbiters

C. B. Farmer, D. W. Davies, A. L. Holland, D. D. LaPorte (Santa Barbara Research Center), and P. E. Doms (University of California, Los Angeles)

J Geophys Res, Vol 82, No 28, pp 4225-4248, September 30, 1977

For abstract, see Farmer, C B

HOLMES, J. K.

H044 Use of A Priori Statistics to Minimize Acquisition Time for RFI Immune Spread Spectrum Systems

J. K. Holmes and K. T. Woo

The Deep Space Network Progress Report 42-46 May and June 1978, pp 62-69, August 15, 1978

A theory is given which allows one to obtain the optimum acquisition sweep strategy of a PN code despreaders when the a priori probability density function is not uniform. This theory has application to pseudo noise spread spectrum systems which could be utilized in the DSN to combat Radio Frequency Interference (RFI). In a sample case, when the a priori probability density function is Gaussian, the acquisition time is reduced by about 41% compared to a "uniform sweep" approach.

HOWE, T. W.

H045 Viking Extended Mission Support

T. W. Howe

The Deep Space Network Progress Report 42-43 November and December 1977, pp 18-23, February 15, 1978

This report covers the period from 1 September through 31 October 1977. It reports on the status of Viking DSN Mark III '77 Data Subsystem Implementation Project (MDS), related testing at DSS 42/43, and also includes reports on the Viking DSN Discrepancy Reporting System, Viking command support, tracking support, and periodic tests conducted with the Viking spacecraft.

H046 Viking Extended Mission Support

T. W. Howe

The Deep Space Network Progress Report 42-44
January and February 1978, pp 34-43, April 15,
1978

This report covers the period from 1 November through 31 December 1977. It reports on DSN support of Viking spacecraft activities during the period and continues reporting on the DSN Discrepancy Reporting System, Viking Command support and Tracking support. It also continues the reports on the status of Viking DSN Mark III Data Subsystem Implementation Project (MDS) related testing.

HSU, C. H.

H047 Electrical Properties of (DEPE) (TCNQ)₄

R. B. Somoano, V. Hadek, S. P. S. Yen,
A. Rembaum, C. H. Hsu (California Institute of
Technology), R. J. Deck (Tulane University),
T. Datta (Tulane University), and
A. M. Hermann (Tulane University)

Phys Stat Sol (B), Vol 81, No 1, pp 281-286,
1977

For abstract, see Somoano, R. B.

HSU, G. C.

**H048 Final Report for Phase I—Coal Desulfurization by
Low Temperature Chlorinolysis**

J. J. Kalvinskas, G. C. Hsu, J. B. Ernest,
D. F. Andress, and D. R. Feller

JPL Publication 78-8, November 23, 1977

For abstract, see Kalvinskas, J. J.

**H049 Coal Desulfurization by Low-Temperature
Chlorinolysis**

G. C. Hsu, J. J. Kalvinskas, P. S. Ganguli, and
G. R. Gavalas (California Institute of Technology)

Coal Desulfurization, ACS Symposium Series, No
64, American Chemical Society, Wash., D. C.,
1977, pp 206-217

There is a need for an economical process of converting high-sulfur coals to clean fuel so that coal can be used as a source of energy without causing serious air pollution. The concept of removing sulfur, particularly organic sulfur, from high-sulfur coals by a simple method of low-temperature chlorinolysis followed by hydrolysis and dechlorination is described. Experimental results and discussion of this method of desulfurization are presented for two bituminous coals.

HUBA, J. D.

H050 Plasma Fluctuations in the Solar Wind

M. Neugebauer, C. S. Wu (University of Maryland,
College Park), and J. D. Huba (Naval Research
Laboratory, Washington, D. C.)

J. Geophys. Res., Vol 83, No A3, pp 1027-1034,
March 1, 1978

For abstract, see Neugebauer, M.

HUBBARD, W. P.

H051 On Improved Ranging

J. W. Layland, A. I. Zygielbaum, and
W. P. Hubbard

The Deep Space Network Progress Report 42-46
May and June 1978, pp 40-45, August 15, 1978

For abstract, see Layland, J. W.

HUMPHREYS, D. W.

**H052 Analysis of DOT Near-Term Transportation
Research, Development, and Demonstration
Activities**

L. E. Baker, D. W. Humphreys, and D. L. Vairin

JPL Publication 78-49, May 15, 1978

For abstract, see Baker, L. E.

HUNG, C.-K.

H053 GCF HSD Error Control

C.-K. Hung

The Deep Space Network Progress Report 42-48
September and October 1978, pp 87-93,
December 15, 1978

A selective repeat Automatic Repeat Request (ARQ) system has been implemented under software control in the GCF Error Detection and Correction (EDC) assembly at JPL and the Comm Monitor and Formatter (CMF) assembly at the DSSs. The CMF and EDC significantly improved real-time data quality and significantly reduced the post-pass time required for replay of blocks originally received in error. Since the Remote Mission Operation Centers (RMOCs) do not provide compatible error correction equipment, error correction will not be used on the RMOC-JPL HSD circuits. The real-time error correction capability will correct error burst or outage of two (2) loop-times or less for each DSS-JPL HSD circuit.

HUNTER, J. A.

H054 Orbiting Deep Space Relay Station, a Study Report

J. A. Hunter

Preprint 78-1639, AIAA Conf on Large Space Platforms Future Needs Capabilities, Los Angeles, Calif, Sept 27-29, 1978

This paper is an interim report on a study that is being carried out at JPL to assess the requirements for tracking and communications with deep space probes in the post 1985 time frame and to evaluate approaches to meeting those requirements. The orbiting deep space relay station (ODSRS) is one approach to meeting those requirements that appears to have some significant advantages over ground based stations. This study will do a detailed conceptual design of an ODSRS and will compare it to other tracking and communications system configuration options. The comparison will include a life cycle cost analysis as well as operations and performance capabilities. Results of the study to date that will be reported in this paper include a preliminary assessment of post 1985 requirements, a discussion of planned ODSRS system capabilities, a discussion of tracking and communications system advantages and problems that are peculiar to an ODSRS, a look at the current status of the conceptual design of the ODSRS, and a summary of the plan for the remainder of the study.

INGHAM, J. D.

I001 Development and Evaluation of Elastomeric Materials for Geothermal Applications—Annual Report, October 1976–October 1977

W. A. Mueller, W. H. Kalfayan, W. W. Reilly, and J. D. Ingham

JPL Publication 78-69, September 1, 1978

For abstract, see Mueller, W. A.

IRELAND, S. J.

I002 Siting Issues for Solar Thermal Power Plants With Small Community Applications

H. J. Holbeck and S. J. Ireland

JPL Publication 78-75, July 20, 1978

For abstract, see Holbeck, H. J.

IRVINE, A.

I003 Evaluation of the DSN Software Methodology

A. Irvine and M. McKenzie

The Deep Space Network Progress Report 42-48
September and October 1978, pp 72-81,
December 15, 1978

This article describes the effects of the DSN software methodology, as implemented under the DSN Programming System, on the DSN Mark III Data Subsystems Implementation Project (MDS). The software methodology is found to provide a markedly increased visibility to management, and to produce software of greater reliability at a small decrease in implementation cost. It is also projected that additional savings will result during the maintenance phase. Documentation support is identified as an area that is receiving further attention.

ISHIMARU, A.

I004 Probing the Solar Wind With Radio Measurements of the Second Moment Field

R. Woo, F. Yang (Dikewood Corporation), and A. Ishimaru (University of Washington)

Astrophys J, Vol 218, No 2, Part 1, pp 557-568, December 1, 1977

For abstract, see Woo, R.

JACKSON, E. B.

J001 Development Support—DSS 13 S-X Unattended Systems Development

E. B. Jackson

The Deep Space Network Progress Report 42-44
January and February 1978, pp 125-130,
April 15, 1978

At DSS 13 (the Venus Station), the subsystems necessary for telemetry reception from spacecraft have been placed under the control of an on-station supervisory computer (Station Controller) and various subsystem controllers, with control inputs originating from Network Operations Control Center (NOCC) at JPL, and monitor inputs from the various Station Subsystems available to the NOCC Operator. The controlled subsystems at DSS 13 include the Antenna and Servo, Microwave Configuration, Block III Receiver, and Subcarrier Demodulator Assembly.

System concepts, overall system description, computer controlled subsystem capabilities, and system testing are discussed. Testing, with control being exercised from NOCC at JPL, has been performed on both Helios and Voyager spacecraft. The test program is continuing.

JACOBSON, A. S.

J002 A Search for the Reported 400-keV γ -ray Line From Crab Nebula

J. C. Ling, W. A. Mahoney, J. B. Willett, and A. S. Jacobson

Nature, Vol. 270, No. 5632, pp 36-37, November 3, 1977

For abstract, see Ling, J. C

JACOBSON, R. A.

J003 A Reformulation of the Linear-Quadratic-Gaussian Stochastic Control Problem for Application to Low Thrust Navigation Analysis

R. A. Jacobson

Preprint 78-1396, AIAA/AAS Astrodyn Conf., Palo Alto, Calif, August 7-9, 1978

The formulation of the classical Linear-Quadratic-Gaussian stochastic control problem as employed in low thrust navigation analysis is reviewed. A reformulation is then presented which eliminates a potentially unreliable matrix subtraction in the control calculations, improves the computational efficiency, and provides for a cleaner computational interface between the estimation and control processes. Lastly, the application of the *U-D* factorization method to the reformulated equations is examined with the objective of achieving a complete set of factored equations for the joint estimation and control problem.

J004 Linear Stochastic Control Using the UDU^T Matrix Factorization

C. L. Thornton and R. A. Jacobson

J Guidance Contr, Vol. 1, No. 4, pp. 232-236, July-August 1978

For abstract, see Thornton, C. L.

J005 Elements of Solar Sail Navigation With Application to a Halley's Comet Rendezvous

R. A. Jacobson and C. L. Thornton

J Guidance Contr, Vol 1, No. 5, pp 365-371, September-October 1978

The problem of interplanetary navigation of a solar sail spacecraft is examined and found to be analogous to that of solar electric spacecraft. The dominant navigation error sources are shown to be accelerations that are unaccounted for in the description of the vehicle's motion, due to the inability to precisely model the solar radiation pressure. A strategy for navigation in the presence of these accelerations is devised, based on techniques previously developed for solar electric vehicles. An evaluation of the strategy is made for a Halley's comet rendezvous mission, and the results of that evaluation

indicate that the strategy gives acceptable performance.

JAFFE, L. D.

J006 Applications of Aerospace Technology to Petroleum Extraction and Reservoir Engineering

L. D. Jaffe, et al.

JPL Publication 78-22, October 30, 1977

The purpose of this study was to determine whether aerospace techniques can help solve significant problems in petroleum extraction and reservoir engineering. Through contacts with the petroleum industry, the petroleum service industry, universities and government agencies, important petroleum extraction problems were identified. For each problem, areas of aerospace technology that might aid in its solution were also identified, where possible. Some of the problems were selected for further consideration. Work on these problems led to the formulation of specific concepts as candidates for development. Each concept is addressed to the solution of specific extraction problems and makes use of specific areas of aerospace technology.

Contributors to this article include:

Jet Propulsion Laboratory: L. D. Jaffe, L. H. Back, C. M. Berdahl, E. E. Collins, Jr., P. G. Gordon, J. Houseman, M. F. Humphrey, G. C. Hsu, J. D. Ingham, J. E. Marte, W. A. Owen, and S. Parthasarathy.

JAIN, A.

J007 Broad Perspectives in Radar for Ocean Measurements

A. Jain

JPL Publication 78-4, February 15, 1978

We evaluate the various active radar implementation options available for the measurement functions of interest for the SEASAT follow-on missions. These functions include surface feature imaging, surface pressure and vertical profile, atmospheric sounding, surface backscatter and wind speed determination, surface current location, wavelength spectra, sea surface topography, and ice/snow thickness. We then examine some concepts for the Synthetic Aperture Imaging Radar that may be useful in the design and selection of the implementation options for these missions. In this evaluation the applicability of these instruments for the VOIR mission is also kept under consideration.

J008 Focusing Effects in the Synthetic Aperture Radar Imaging of Ocean Waves

A. Jain

Appl Phys, Vol 15, No 3, pp 323-333,
March 1978

We derive the properties of the image obtained for an ocean wave whose cross-section may be given by $\sigma_w(x,y,t)$ and surface profile by $h(x,y,t)$. σ_w and h are functions representing the wave phenomena, but whose exact properties are determined by the ocean wave surface properties, for an ocean wavelength of λ_w , height H , and orbital frequency ω . We calculate the effect of defocusing of the wave image due to its temporal motion, and derive both the resolution of the radar system if no focus compensation is provided in the processor and the necessary distance the azimuth telescope has to be moved to provide diffraction-limited imaging. We illustrate these results for data taken by the JPL synthetic aperture radar over Hurricane Gloria on September 30, 1976, and the ERIM radar over Marineland, Florida, on December 15, 1975.

JANSSEN, M. A.

J009 Evidence for the Depletion of Ammonia in the Uranus Atmosphere

S. Gulkis, M. A. Janssen, and E. T. Olsen
Icarus, Vol 34, No 1, pp 10-19, April 1978

For abstract, see Gulkis, S

JENSEN, S.

J010 Experimental Differential and Integral Electron Impact Cross Sections for the $B^1\Sigma_u^+$ State of H_2 in the Intermediate-Energy Region

S. K. Srivastava and S. Jensen (University of California, Riverside)

J Phys B At Mol Phys, Vol 10, No 16, pp 3341-3346, 1977

For abstract, see Srivastava, S. K

JENSEN, W. N.

J011 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and
G. M. Rockwell

The Deep Space Network Progress Report 42-44
January and February 1978, pp 50-53, April 15, 1978

For abstract, see Goodwin, P. S

J012 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and
G. M. Rockwell

The Deep Space Network Progress Report 42-45
March and April 1978, pp 101-103, June 15, 1978

For abstract, see Goodwin, P. S

J013 Helios Mission Support

P. S. Goodwin, G. M. Rockwell, and
W. N. Jensen

The Deep Space Network Progress Report 42-46
May and June 1978, pp 37-39, August 15, 1978

For abstract, see Goodwin, P. S

J014 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and
G. M. Rockwell

The Deep Space Network Progress Report 42-47
July and August 1978, pp 26-28, October 15, 1978

For abstract, see Goodwin, P. S

J015 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and
G. M. Rockwell

The Deep Space Network Progress Report 42-48
September and October 1978, pp 15-17,
December 15, 1978

For abstract, see Goodwin, P. S

JERATH, N.

J016 Interplanetary Approach Optical Navigation With Applications

N. Jerath

JPL Publication 78-40, June 1, 1978

An investigation is conducted into the use of optical data from onboard television cameras for the navigation of interplanetary spacecraft during the planet approach phase. Three optical data types are investigated: the planet limb with auxiliary celestial references, the satellite-star and the planet-star two-camera methods. Analysis and modelling issues related to the nature and information content of the optical methods are examined. Dynamic and measurement system modelling, data sequence design, measurement extraction, model estimation and orbit determination, as relating to optical navigation, have been discussed. The various error sources are analysed. The methodology developed has been ap-

plied to the Mariner 9 and the Viking Mars Missions. Navigation accuracies are evaluated at the control and knowledge points, with particular emphasis devoted to the combined use of radio and optical data. A parametric probability analysis technique is developed to evaluate navigation performance as a function of system reliabilities.

It has been determined that Optical Navigation can be a very effective means of navigating an interplanetary spacecraft during its approach phase to the planet, particularly with the combined use of radio and optical data. Of the three observation methods examined, the satellite-star method is found most suited for the knowledge point and the planet-star two-camera method for the control point. It has been shown that optical and radio data provide complementary navigation information and their major error sources are different; their combination yields the best results. However, delaying the maneuver timing as much as feasible maximizes the benefit from the strength of optical data. A method developed to evaluate consistency between the optical and radio solutions is shown to be very effective in the detection of data anomalies.

JET PROPULSION LABORATORY

J017 Proceedings of the DOE Chemical Energy Storage and Hydrogen Energy Systems Contracts Review

Jet Propulsion Laboratory

JPL Publication 78-1, February 15, 1978

The Chemical Energy Storage and Hydrogen Energy Systems Contracts Review was held at the Hunt Valley Inn, Hunt Valley, Maryland, on November 16-17, 1977. This Contracts Review meeting, scheduled annually by the Chemical and Thermal Branch of the DOE Division of Energy Storage Systems (STOR), was coordinated for DOE by the Jet Propulsion Laboratory in accordance with a task defined in the interagency agreement (EC-77-A-31-1035) between DOE and the NASA Office of Energy Programs. The meeting served as an effective means to (1) give all participants an insight into the background and objectives of thirty-nine hydrogen-related tasks, (2) show the status of the studies or technical effort, (3) relate any problems that had impeded progress, and (4) state projected solutions for resolving the identified problems. Approximately 100 representatives from government and the private sector participated in the Contracts Review.

Prepared for the Department of Energy

J018 LSSA (Low-Cost Silicon Solar Array) Project—Project Quarterly Report 5, for the Period April 1977-June 1977

Jet Propulsion Laboratory

JPL Publication 78-9

This report describes the activities of the Low-Cost Silicon Solar Array Project during the period April through June, 1977. The LSSA Project is assigned responsibility for advancing silicon solar array technology while encouraging industry to reduce the price of arrays to a level at which photovoltaic electric power systems will be competitive with more conventional power sources early in the next decade. Set forth here are the goals and plans with which the Project intends to accomplish this, and the progress that was made during the quarter.

Prepared for the Department of Energy, DOE/JPL-1012-77/4, Distribution Category UC-63

J019 Proceedings of Small Power Systems Solar Electric Workshop, Held at Aspen, Colorado, October 10-12, 1977: Executive Summary

Jet Propulsion Laboratory

JPL Publication 78-10, Vol I, February 1978

This Executive Summary describes the background, objectives and methodology used for the Small Power Systems Solar Electric Workshop, held October 10-12, 1977, in Aspen, Colorado, and presents a summary of the results and conclusions developed at the workshop regarding small solar thermal electric power systems.

Prepared for the Department of Energy, DOE/JPL-1060-78/1, Distribution Category UC-62

J020 Proceedings of Small Power Systems Solar Electric Workshop, Held at Aspen, Colorado, October 10-12, 1977: Invited Papers

Jet Propulsion Laboratory

JPL Publication 78-10, Vol II, February 1978

The Jet Propulsion Laboratory (JPL) sponsored a solar power workshop in conjunction with their Small Power Systems Applications project, on October 10 through 12, 1977, in Aspen, Colorado. The project is managed by JPL for the U.S. Department of Energy (DOE). The workshop's primary purposes were (1) to acquaint the utility community with JPL's Small Power Systems Applications project, and (2) to gain input from utilities regarding their needs as they affect the development of solar thermal electric technology.

The workshop presented the commitment of the DOE and JPL to the development of solar thermal power plants in the 1 to 50 MWe range for a variety of applications including utility applications; the focus of this workshop. Workshop activities included panel discussions, formal presentations, small group interactive discussions, question and answer periods, and informal gatherings. Effective interchange of ideas and information

was gained by emphasis on participation and discussion. Discussion on topics included solar power technology options, solar thermal power programs currently underway at the DOE, JPL, Electric Power Research Institute (EPRI), and Solar Energy Research Institute (SERI), power options competing with solar, institutional issues, environmental and siting issues, financial issues, energy storage, site requirements for experimental solar installations, utility planning.

It was concluded that many of the problems associated with the implementation of any new technology, or the siting of new power plants, also apply to solar thermal power. However, several issues and conclusions were identified that are unique to solar power technology development. These issues and the results from the small group discussions are summarized in the proceedings.

Prepared for the Department of Energy, DOE/JPL-1060-78/1, Distribution Category UC-62

J021 Jet Propulsion Laboratory 1976-1977 Annual Report

Jet Propulsion Laboratory

JPL Publication 78-14, Rev 1, April 1978

A description of work accomplished under Contract NAS 7-100 between the California Institute of Technology and the National Aeronautics and Space Administration for the period July 1, 1976, to September 30, 1977.

J022 Dynamics of Earth and Planetary Atmospheres: A Brief Assessment of Our Present Understanding

Jet Propulsion Laboratory

JPL Publication 78-46, May 1, 1978

This article presents a report of the Planetary Atmospheres Workshop, held July 10 through 16, 1977, at Snowmass, Colorado. Contributors examine how an opportunity to look at planets other than our own can be used to greatest advantage, and attempt to assess progress in the application of existing observations to planetary atmosphere theory, as well as to identify gaps in both theory and practice.

Although the central theme is the fluid dynamical aspect of planetary atmospheres, neither the terrestrial climate nor the climates of the other planets are divorced from other physical or chemical processes. In addition, several specific terrestrial problem areas in which prior planetary studies have speeded developments are identified, including parameterizations of radiative heating, the photochemistry of the stratosphere, and parameterizations of heat transport by large-scale eddies for use in climate models.

J023 Standard Practices for the Implementation of Computer Software

Jet Propulsion Laboratory

JPL Publication 78-53, September 1, 1978

Standard Practices for the Implementation of Computer Software provides a standard approach to the development of computer programs. This approach covers the life cycle of software development from the Planning and Requirements phase through the Software Acceptance Testing phase. All documents necessary to provide the required visibility into the software life cycle process are discussed in detail.

J024 Upper Atmosphere Research Satellite Program: Final Report of the Science Working Group

Jet Propulsion Laboratory

JPL Publication 78-54, July 15, 1978

A Science Working Group was established in October 1977 by the Solar-Terrestrial Office of the Office of Space Sciences, NASA, to develop a satellite program to conduct research on the chemistry, energetics, and dynamics of the upper atmosphere. This publication is the final report of that Group, and outlines the scientific goals of the Upper Atmospheric Research Program, the Program requirements, and the approach toward meeting those requirements. An initial series of two overlapping spacecraft missions is described. Both spacecraft are launched and recovered by the STS, one in the winter of 1983 at a 56-deg inclination, and the other a year later at a 70-deg inclination. The duration of each mission is 18 months, and each carries instruments to make global measurements of the temperature, winds, composition, irradiation, and radiance in the stratosphere, mesosphere, and lower thermosphere between the tropopause and 120-km altitude. The program requires a dedicated ground-based data system and a science team organization that leads to a strong interaction between the experiments and theory. The Program is a natural evolution from the present planned series of atmosphere research satellites, and includes supportive observations from other platforms such as rockets, balloons, and the Space-lab.

J025 Proceedings of the Conference on Coal Use for California

Jet Propulsion Laboratory

JPL Publication 78-56, August 15, 1978

These proceedings contain the papers, statements, and panel session transcriptions that resulted from the Coal Use for California Conference that was held in Pasadena, California from 9 through 11 May 1978. The conference brought together approximately 400 specialists, students, and members of interest groups and the general public for the examination of technological, institutional, and social issues surrounding coal use for California and the

identification of attendant constraints, impediments, advantages, and target opportunities. The expertise of the participants covers a wide range of subject matter that includes systems examination of coal opportunities, energy demand forecasting, environmental aspects of coal use, coal supply and transport, viewpoint of neighboring states, air pollution control, direct firing, coal gasification and liquefaction technologies, economics of coal use, and the regulatory system.

Prepared for the Federal Department of Energy and the California Energy Commission.

J026 A Close-Up of the Sun

Jet Propulsion Laboratory

JPL Publication 78-70, September 1, 1978

NASA's long-range plan for the study of solar-terrestrial relations includes a Solar Probe Mission in which a spacecraft is put into an eccentric orbit with perihelion near 4 solar radii (0.02 AU). The scientific experiments which might be done with such a mission are discussed in this report. Topics included are the distribution of mass within the Sun, solar angular momentum, the fine structure of the solar surface and corona, the acceleration of the solar wind and energetic particles, and the evolution of interplanetary dust. The mission could also contribute to high-accuracy tests of general relativity and the search for cosmic gravitational radiation.

J027 JPL Basic Research Review

Jet Propulsion Laboratory

JPL Publication 78-79, September 1978

Results, current status and projected goals for some fifty Research and Advanced Development programs at the Jet Propulsion Laboratory are reported in abstract form.

Some of the papers are presented orally to the NASA OAST Council while others are provided to delineate additional work in progress at the Laboratory.

J028 LSA (Low-Cost Solar Array) Project—Project Quarterly Report 6, for the Period July 1977–September 1977

Jet Propulsion Laboratory

JPL Publication 78-83

This report describes the activities of the Low-Cost Silicon Solar Array Project during the period July through September, 1977. The LSSA Project is assigned responsibility for advancing silicon solar array technology while encouraging industry to reduce the price of arrays to a level at which photovoltaic electric power systems will be competitive with more conventional power sources early in the next decade. Set forth here are

the goals and plans with which the Project intends to accomplish this, and the progress that was made during the quarter.

Prepared for the Department of Energy, DOE/JPL-1012-78/2, Distribution Category UC-63b

J029 Final Report of the Ad Hoc Mars Airplane Science Working Group

Jet Propulsion Laboratory

JPL Publication 78-89, November 1, 1978

This report documents the findings of the Ad Hoc Mars Airplane Science Working Group, which was formulated in early 1978 to assess the utility of a remotely piloted airplane for scientific exploration. Although an airplane can be used in several modes, e.g., aerial survey, landing science instruments for in situ investigations, deploying network science by air drop, or sample collection and transport to a central site, only the aerial survey mode was considered in detail. Five experiment areas were chosen to evaluate the airplane's capability in this mode: visual imaging, gamma ray and infrared reflectance spectroscopy, gravity field, magnetic field and electromagnetic sounding, and atmospheric composition and dynamics. The Working Group concluded that the most important use of a plane in the aerial survey mode would be in topical studies and returned sample site characterization. The airplane offers the unique capability to do high resolution, oblique imaging, and repeated profile measurements in the atmospheric boundary layer. It offers the best platform from which to do electromagnetic sounding. It is an adaptable vehicle that has the potential to offer many promising options, such as the possibility of deploying instruments and sample collection in the polar regions, which are inaccessible with soft landers or rovers.

J030 Proceedings: Conference on the Programming Environment for Development of Numerical Software

Jet Propulsion Laboratory

JPL Publication 78-92, October 18, 1978

This publication contains the proceedings of the Conference on the Programming Environment for Development of Numerical Software, cosponsored by JPL and ACM-SIGNUM, and held at the Hilton Hotel, Pasadena, California, October 18–20, 1978.

J031 LSA (Low-Cost Solar Array) Project—Project Quarterly Report 7, for the Period October 1977–December 1977

Jet Propulsion Laboratory

JPL Publication 78-97

This report describes the activities of the Low-Cost Silicon Solar Array Project during the period October through December, 1977. The LSSA Project is assigned responsibility for advancing silicon solar array technology while encouraging industry to reduce the price of arrays to a level at which photovoltaic electric power systems will be competitive with more conventional power sources early in the next decade. Set forth here are the goals and plans with which the Project intends to accomplish this and the progress that was made during the quarter.

JOHNSON, T. V.

J032 The Galilean Satellites of Jupiter: Four Worlds

T. V. Johnson

Ann Rev Earth Planet Sci, Vol 6, pp 93-125, 1978

A broad survey is presented of our current knowledge of the Galilean satellites. Attention is given to the physical properties (size, masses, densities, and rotation) and to the surface properties (albedo, surface markings, composition, and physical state) of the satellites. In particular, Io's atmosphere is considered with emphasis on the sodium, hydrogen and sulfur clouds and the ionosphere. The atmospheres of the other satellites are examined briefly and consideration is given to models of planetary origin, evolution, and interior structure.

J033 Sodium D-Line Emission From Io: Comparison of Observed and Theoretical Line Profiles

R. W. Carlson, D. L. Matson, T. V. Johnson, and J. T. Bergstralh

Astrophys J, Vol 223, pp 1082-1086, August 1, 1978

For abstract, see Carlson, R. W.

J034 Postperihelion Interference Filter Photometry of the "Annual" Comet P/Encke

R. L. Newburn, Jr. and T. V. Johnson

Icarus, Vol 35, pp 360-368, 1978

For abstract, see Newburn, R. L., Jr.

J035 Soil Maturity and Planetary Regoliths: The Moon, Mercury, and the Asteroids

D. L. Matson, T. V. Johnson, and G. V. Veeder

Proc Eighth Lunar Sci Conf, Houston, Tex., March 14-18, 1977, pp 1001-1011

For abstract, see Matson, D. L.

J036 Lunar Spectral Units: A Northern Hemispheric Mosaic

T. V. Johnson, J. A. Mosher, and D. L. Matson

Proc Eighth Lunar Sci Conf, Houston, Tex., March 14-18, 1977, pp 1013-1028

We present a multispectral mosaic of much of the northern hemisphere of the moon. The data base was obtained using our Silicon Imaging Photometer System (SIPS) and consists of individual spectral ratio mosaics of 0.38/0.56, 0.85/0.38, and 1.05/0.56 μm , color ratio composites and computer classification maps based on these ratios and the basalt types identified by Pieters and McCord (1976). The mosaics are in Mercator projection for ease of comparison with other data sets and have been photometrically compared with previous point spectrophotometry. Among the results from a preliminary examination of these data are (1) Confirmation of the wide distribution of mare basalt types apparently not sampled by the Apollo or Luna programs, (2) Identification of apparent dark mantling material not only in previously studied Lunar Black Spots but also in several small areas surrounding Serenitatis, and (3) The observation of many localities including Sulpicius Gallus, that have the high infrared reflectance characteristic of the Black Spots but not the high ultraviolet spectral signature. It is suggested that these areas may be relatively more rich in orange glass compared to the crystalline black spheres found at the Apollo 17 site. The Aristarchus plateau does not appear to have this spectral signature.

J037 A TiO_2 Abundance Map for the Northern Maria

T. V. Johnson, R. S. Saunders, D. L. Matson, and J. A. Mosher

Proc Eighth Lunar Sci Conf, Houston, Tex., March 14-18, 1977, pp 1029-1036

We present a map of TiO_2 abundance for most of the northern maria. The telescopic data base used is the 0.38/0.56 μm ratio mosaic from Johnson *et al* (1977). The titanium content has been estimated using the correlation established by Charette *et al* (1974). Combining observational, processing, and calibration errors we feel the TiO_2 map is accurate to $\pm 2\%$ (wt % TiO_2) for high TiO_2 content ($>5\%$) and $\pm 1\%$ for low values of TiO_2 . Analysis of the lunar sample and telescopic data suggests strongly that the spectral parameter mapped is sensitive primarily to TiO_2 abundance in the range 3-9% and does not correlate directly with iron content. It is suggested, however, that for the low TiO_2 mare regions ($<2-3\%$ TiO_2) there may be a relation between the spectral ratio and iron content and that some of the reddest mare in the Imbrium region may have low iron contents as well as low titanium abundances.

J038 Asteroids and Comparative Planetology

D. L. Matson, F. P. Fanale, T. V. Johnson, and
G. J. Veeder

*Proc. Seventh Lunar Sci. Conf., Houston, Tex.,
March 15-19, 1976, pp. 3603-3627*

For abstract, see Matson, D. L.

J039 Images of Io's Sodium Cloud

D. L. Matson, B. A. Goldberg, T. V. Johnson, and
R. W. Carlson

Science, Vol. 199, pp. 531-533, February 3, 1978

For abstract, see Matson, D. L.

JOHNSTON, A. R.

**J040 Automated Mixed Traffic Vehicle (AMTV)
Technology and Safety Study**

A. R. Johnston, T. K. C. Peng, H. C. Vivian, and
P. K. Wang

JPL Publication 78-12, February 1978

This report discusses technology and safety related to the implementation of an Automated Mixed Traffic Vehicle (AMTV) system. System concepts and technology status are reviewed and areas where further development is needed are identified. Failure and hazard modes are also analyzed and methods for prevention are suggested. The results presented are intended as a guide for further efforts in AMTV system design and technology development for both near-term and long-term applications.

The AMTV systems discussed include a low-speed system, and a hybrid system consisting of low-speed sections and high-speed sections operating in a semi-guideway.

Needed technology includes further development of headway sensing devices, and development of flexible, and fail-safe control hardware.

The safety analysis identified hazards that may arise in a properly functioning AMTV system, as well as hardware failure modes. Safety-related failure modes were emphasized. A risk assessment was performed in order to create a priority order and significant hazards and failure modes were summarized. Corrective measures were proposed for each hazard.

Prepared for the U.S. Department of Transportation,
Report No. UMTA-CA-06-0088-78-1

**J041 Wide Area Detection System Conceptual Design
Study**

E. E. Hilbert, C. Carl, W. Goss, G. R. Hansen,
M. J. Olsasky, and A. R. Johnston

JPL Publication 78-32, February 1978

For abstract, see Hilbert, E. E.

JOHNSTON, D. W. H.

J042 Pioneer Mission Support

D. W. H. Johnston

*The Deep Space Network Progress Report 42-46
May and June 1978, pp. 33-36, August 15, 1978*

This article covers the time period from 1 January 1978 through 31 May 1978. Ongoing Pioneer Project Operations (Pioneers 6 through 11) are briefly mentioned. The DSN prelaunch preparations and launch operations for the Pioneer Venus Orbiter are described in detail, along with a brief update on the Pioneer Venus Multiprobe launch and encounter preparations.

JONES, K. L.

J043 Processing the Viking Lander Camera Data

E. C. Levinthal (Stanford University), W. Green,
K. L. Jones (Brown University), and
R. Tucker (Stanford University)

J. Geophys. Res., Vol. 82, No. 28, pp. 4412-4420
September 30, 1977

For abstract, see Levinthal, E. C.

JURGENS, R.

J044 Planetary Benchmarks

C. Uphoff, R. Staehle, M. Kobrick, R. Jurgens,
H. Price, M. Slade, and D. Sonnabend

JPL Publication 78-94, December 1, 1978

For abstract, see Uphoff, C.

KAHLE, A. B.

**K001 Evaluation of Landsat MSS vs TM Simulated Data
for Distinguishing "Hydrothermal Alteration"**

M. J. Abrams, A. B. Kahle, D. P. Madura, and
J. M. Soha

JPL Publication 77-83, March 1, 1978

For abstract, see Abrams, M. J.

KAKAR, R. K.

**K002 The Rotational Spectrum and Molecular Parameters
of ClO in the $v = 0$ and $v = 1$ States**

R. K. Kakar, E. A. Cohen, and M. Geller

J Mol Spectros, Vol 70, pp 243-256, 1978

The $J = 9/2 \leftarrow 7/2$, $^2\Pi_{3/2}$ and $^2\Pi_{1/2}$, ground vibrational state transitions of ^{35}ClO and ^{37}ClO and the $^2\Pi_{3/2}$, excited vibrational state transitions of ^{35}ClO have been observed in the 164-167 GHz region. Additional measurements have also been made on the $J = 3/2 \leftarrow 1/2$ and $J = 5/2 \leftarrow 3/2$ transitions of both the ground and excited vibrational states. All measurements were made using millimeter oscillators which were phase locked to harmonics of a Hewlett-Packard microwave spectrometer's X-band source. Λ -doubling splitting of a few $^2\Pi_{3/2}$ transitions was resolved.

When magnetic and nuclear quadrupole hyperfine terms off-diagonal in J and Ω in the Hund's case (a) representation were included in addition to the usual diagonal terms, an excellent fit to all of our observed transitions resulted. The most significant change from previously determined parameters is the centrifugal distortion constant D for which the values, $D_0 = 0.03972(26)$ MHz for ^{35}ClO , $D_0 = 0.03888(32)$ MHz for ^{37}ClO and $D_1 = 0.0395(21)$ MHz for ^{35}ClO are obtained. Values of $1.56959(1)$ Å for the equilibrium bond length and $854(7)$ cm^{-1} for the equilibrium vibrational frequency are derived from the measured spectra. In addition, values for the Λ -doubling constant β_p and the quadrupole coupling constant eQq_2 were derived from the measured spectra for the first time.

KALFAYAN, W. H.

K003 Development and Evaluation of Elastomeric Materials for Geothermal Applications—Annual Report, October 1976–October 1977

W. A. Mueller, W. H. Kalfayan, W. W. Reilly, and J. D. Ingham

JPL Publication 78-69, September 1, 1978

For abstract, see Mueller, W. A.

KALVINSKAS, J. J.

K004 Final Report for Phase I—Coal Desulfurization by Low Temperature Chlorinolysis

J. J. Kalvinskas, G. C. Hsu, J. B. Ernest, D. F. Andress, and D. R. Feller

JPL Publication 78-8, November 23, 1977

The Final Report for Phase I of the Coal Desulfurization by Low Temperature Chlorinolysis project conducted by the Jet Propulsion Laboratory under U.S. Bureau of Mines Contract NO. J0177103 for the period of July 6, 1977 through November 6, 1977 is presented here. The reported activity covers laboratory scale experiments on

twelve bituminous, sub-bituminous and lignite coals, and preliminary design and specifications for bench-scale and mini-pilot plant equipment. A Phase II follow-on program will be carried out that includes bench-scale and mini-pilot plant construction and operation. The combined Phase I and Phase II programs are discussed in JPL Proposal 70-763 for "Coal Desulfurization by Low Temperature Chlorinolysis," dated December 30, 1976.

Prepared for the Department of Energy

K005 Coal Desulfurization by Low-Temperature Chlorinolysis

G. C. Hsu, J. J. Kalvinskas, P. S. Ganguli, and G. R. Gavalas (California Institute of Technology)

Coal Desulfurization, ACS Symposium Series, No 64, American Chemical Society, Wash., D. C., 1977, pp 206-217

For abstract, see Hsu, G. C.

KANBER, H.

K006 Fourth-Order Acoustic Torque in Intense Sound Fields

T. G. Wang, H. Kanber, and E. E. Olli

J Acoust Soc Amer, Vol 63, No. 5, pp 1332-1334, May 1978

For abstract, see Wang, T. G.

KATOW, M. S.

K007 NASTRAN Analysis of a Wheel-Rail Loading on Its Foundation

M. S. Katow

The Deep Space Network Progress Report 42-43 November and December 1977, pp 204-215, February 15, 1978

One type of azimuth bearing for a large ground antenna (100 m) will consist of steel wheels, mounted at four corners of the alidade, rolling on a circular flat rail which provides the vertical restraints, a radial constraining bearing at the center of the alidade provides the horizontal restraints. One important design feature is the compressive stresses in the grout or concrete foundation under the wheel-rail load.

This report describes a finite element analysis check of a particular design by H. McGinness that consists of a steel rail resting on a concrete foundation. Symmetry is assumed as much as possible in order to minimize the models, but meaningful element sizes are used. Recently developed isoparametric hexahedron elements available

in the NASTRAN computing program, which minimizes the number of elements required while maintaining the accuracy of the computed stresses, are used with two versions of NASTRAN Test cases to check with the analytical solutions are made. A side loading is also applied to calculate the increase in the concrete stresses

K008 LAASP 100-m Antenna Wind Performance Studies

R. Levy and M. S. Katow

The Deep Space Network Progress Report 42-44: January and February 1978, pp. 104-113, April 15, 1978

For abstract, see Levy, R.

K009 Structural Design of a 64-Meter Low-Cost Antenna

M. S. Katow

The Deep Space Network Progress Report 42-45: March and April 1978, pp. 258-275, June 15, 1978

The computer model of a 64-m ground antenna was almost completely generated by 1108 software. The reflector and alidade model was iteratively designed and analyzed by the JPL/IDEAS program, which minimized the distortion RMS with respect to the structural weight. Curves of values describing the optimizing processes are presented, functional aspects of the structural elements are defined, and detail descriptions of the design equations for stress calculations are included. Computed data used for calculating the RF boresight error and natural frequency answers are also included.

KEESEY, M. S. W.

K010 Tests of General Relativity Using Astrometric and Radio Metric Observations of the Planets

J. D. Anderson, M. S. W. Keeseey, E. L. Lau, E. M. Standish, Jr., and X. X. Newhall

Astronautica, Vol. 5, pp. 43-61, 1978

For abstract, see Anderson, J. D.

KELLEY, J. H.

K011 Storage, Transmission and Distribution of Hydrogen

J. H. Kelley and R. Hegler, Jr.

Hydrogen Energy System Proc. Second World Hydrogen Energy Conf., Zurich, Switzerland, August 21-24, 1978, pp. 25-53, Pergamon Press, New York, N.Y., 1978

Current practices and future requirements for the storage, transmission and distribution of hydrogen are dis-

cussed and analyzed to identify demonstrated or anticipated inadequacies which must be corrected before hydrogen utilization can achieve full potential as a substitute for diminishing supplies of fossil fuels. These inadequacies are presented as challenges for research and development activities to eliminate impediments to the increased utilization of hydrogen.

KEMP, R. P.

K012 Pioneer Venus 1978 Deep Space Network Telecommunications Compatibility Test Program Status

A. I. Bryan and R. P. Kemp

The Deep Space Network Progress Report 42-45: March and April 1978, pp. 39-100, June 15, 1978

For abstract, see Bryan, A. I.

KENDALL, J. M., SR.

K013 Analysis and Tests of a Wide Angle Radiometer Viewlimiter

J. M. Kendall, Sr.

JPL Publication 78-63, October 15, 1978

A general analysis of radiometer viewlimiters is made, and detailed computations of the angular response of a viewlimiter of wide acceptance angle are given.

While the example computed in this report is for a wide angle viewlimiter, the analysis holds as well for all viewlimiters of intermediate and small viewing acceptance angles. No approximations have been made.

K014 Calibration Standards and Field Instruments for the Precision Measurement of Insolation

M. S. Reid, C. M. Berdahl, and J. M. Kendall, Sr.

Solar Energy, Vol. 20, pp. 357-358, 1978

For abstract, see Reid, M. S.

KENT, S. S.

K015 Predetection Telemetry Analog Recording and Playback for Pioneer Venus 1978

S. S. Kent

The Deep Space Network Progress Report 42-43: November and December 1977, pp. 197-203, February 15, 1978

Equipment and techniques have been developed to assure the DSN will meet the 1.5-dB degradation commit-

ment to the mission for data recovery during the mission probes encounter

KEYSER, L. F.

K016 Absolute Rate and Temperature Dependence of the Reaction Between Chlorine (2P) Atoms and Methane

L. F. Keyser

J Chem Phys, Vol 69, No 1, pp. 214-218,
July 1, 1978

The absolute rate of the reaction $\text{Cl}(^2P) + \text{CH}_4 \rightarrow \text{HCl} + \text{CH}_3$ was determined between 220 and 423 K using the discharge flow-resonance fluorescence technique. Evidence of curvature is observed in the Arrhenius plot. The present results are compared with earlier absolute rate measurements.

KHANNA, S. K.

K017 Optical, Spin-Resonance, and Magnetoresistance Studies of (Tetrathiatetracene) $_2$ (Iodide) $_3$. The Nature of the Ground State

R. B. Somoano, S. P. S. Yen, V. Hadek,
S. K. Khanna, M. Novotny (Stanford University),
T. Datta (Tulane University),
A. M. Hermann (Tulane University), and
J. A. Woollam (Lewis Research Center)

Phys Rev, Pt B Solid State, Vol. 17, No 7, pp
2853-2857, April 1, 1978

For abstract, see Somoano, R. B

KIMBALL, K. R.

K018 Implementation of the Radio Science Subsystem in the DSN

K. R. Kimball

The Deep Space Network Progress Report 42-45
March and April 1978, pp 282-287, June 15,
1978

The DSN is implementing a new subsystem for support of radio science data acquisition requirements beginning in late 1978. The article describes the functional characteristics of this equipment and utilizes the factors that were of major importance in the design and implementation approach.

KIRSCHMAN, R. K.

K019 Photomask and Pattern Programming Manual

R. K. Kirschman

JPL Publication 77-32, March 1, 1978

This document is a user's manual for a set of computer programs for the layout and generation of photomasks. Also included is a limited amount of related information on photomasks, their design and use. The programs and this manual would be most useful to persons having a moderate need for photomasks for prototype or research purposes.

The source language for the programs is extended FORTRAN. To use the programs, data describing the photomask design is input to the programs, provisions for scaling, repetition, complex geometries, etc., allow simplifications in the preparation of the input data. The possible outputs are plots of the layout and a magnetic tape for controlling generation of the photomask by a pattern generator.

KLAASEN, K. P.

K020 Inflight Performance of the Viking Visual Imaging Subsystem

K. P. Klaasen, T. E. Thorpe, and L. A. Morabito

Appl Opt, Vol 16, pp 3158-3170,
December 1977

Photography from the Viking Orbiter Visual Imaging Subsystem, taken while en route to and in orbit about Mars, has been analyzed to determine the performance of the cameras. The cameras have remained in good focus. Random and coherent noise levels in flight were the same as measured prior to launch. A recalibration of each instrument allows photometric measurements to accuracies of less than 3% for relative measurements and 9% for absolute measurements. Geometric distortion remained close to the preflight levels of 4 pixels rms and 11 pixels maximum.

KLEIN, M. J.

K021 Evidence of an Increase in the Microwave Brightness Temperature of Uranus

M. J. Klein and J. A. Turegano

Astrophys J, Vol 224, pp L31-L34, August 15,
1978

New measurements are reported which indicate that the microwave brightness temperature of Uranus near 3 cm wavelength has increased ~35% in the past decade. We suggest that changes of this magnitude could be caused by seasonal or latitudinal variations of the microwave opacity of the Uranus atmosphere. The data appear to be inconsistent with models of synchrotron emission from a trapped radiation belt.

K022 Jupiter's Atmosphere: Observations and Interpretation of the Microwave Spectrum Near 1.25-cm Wavelength

M. J. Klein and S. Gulkis

Icarus, Vol 35, pp 44-60, 1978

Measurements of Jupiter's disk-temperature spectrum in the 20- to 24-GHz ($1.5 \text{ cm} < \lambda < 1.25 \text{ cm}$) region are reported. These data are combined with previously published data to produce a uniformly calibrated thermal spectrum of Jupiter in the wavelength interval 0.85 to 2.1 cm. Model studies are carried out to determine optimum pressure-temperature profiles for an assumed radiative-convective temperature structure. We find the temperature at the 1-bar total effective pressure level is between 140 and 165°K, with a most probable value of 153°K provided that NH_3 is uniformly saturated in the clouds on a global scale. We show that the temperature profile for the microwave model is $\sim 20^\circ\text{K}$, cooler than the profiles derived from infrared data. An explanation of this discrepancy is discussed in terms of a model which invokes different NH_3 distributions in the belts and zones.

KLOSE, G.

K023 Automotive Technology Status and Projections: Executive Summary

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol I, June 1978

For abstract, see Dowdy, M

K024 Automotive Technology Status and Projections: Assessment Report

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol II, June 1978

For abstract, see Dowdy, M

KLOSE, G. J.

K025 Weight Propagation and Equivalent Horsepower for Alternate-Engined Cars

G. J. Klose and D. W. Kurtz

Preprint 780348, SAE Congress and Exposition, Detroit, Mich., February 27-March 3, 1978

In order to properly evaluate the consequences of replacing conventional Otto-cycle engines with alternate power systems, comparisons must be carried out at the vehicle level with functionally equivalent cars. This paper pre-

sents the development and application of a procedure for establishing equivalent vehicles. A systematic weight propagation methodology, based on detailed weight breakdowns and influence factors, yields the vehicle weight impacts due to changes in engine weight and power. Performance-matching criteria, utilizing a vehicle simulation program, are then employed to establish Otto-engine-equivalent vehicles, whose characteristics can form the basis for alternative engine evaluations.

KOBRICK, M.

K026 Planetary Benchmarks

C. Uphoff, R. Staehle, M. Kobrick, R. Jurgens, H. Price, M. Slade, and D. Sonnabend

JPL Publication 78-94, December 1, 1978

For abstract, see Uphoff, C

KOHLHASE, C. E.

K027 Voyager Mission Description

C. E. Kohlhase and P. A. Penzo

Space Sci. Rev., Vol. 21, No. 2, pp 77-101, November 1977

The Voyager Project, managed by the Jet Propulsion Laboratory, involves the launching of two advanced spacecraft to explore the Jovian and Saturnian systems, as well as interplanetary space. The one-month launch period opens on August 20, 1977, with arrivals at Jupiter in March and July of 1979, and at Saturn in November of 1980 and August of 1981. Gravity-assist swingbys of Jupiter are utilized in order to reduce the launch energy demands needed to reach Saturn. In addition, a gravity-assist targeting option at Saturn will be maintained on the second-arriving Voyager for a possible continuation on to Uranus, with arrival in January of 1986. Flight through the Jovian and Saturnian systems will achieve close to moderate flyby encounters with several of the natural satellites, including special flyby geometry conditions for Io and Titan, as well as an Earth occultation of the spacecraft's radio signal by the rings of Saturn. The purpose of this paper is to describe the Voyager mission characteristics in order to establish a framework upon which to better understand the objectives and goals of the eleven scientific investigations which are described in subsequent papers.

KOLIWAD, K. M.

K028 Effect of Multiblade Slurry Saw Induced Damage on Silicon Solar Cells

T. Daud, J. K. Liu, G. A. Pollock, and K. M. Koliwad

Conf Rec Thirteenth IEEE Photovoltaic Spec Conf, Washington, D C, June 5-8, 1978, pp 142-146

For abstract, see Daud, T

K029 Effect of Copper Impurity on Polycrystalline Silicon Solar Cells

T. Daud and K. M. Koliwad

Conf Rec Thirteenth IEEE Photovoltaic Spec Conf, Washington, D C, June 5-8, 1978, pp 503-506

For abstract, see Daud, T

KRAUSS, R.

K030 Dust Storms: Great Plains, Africa, and Mars

P. M. Woiceshyn, R. Krauss (University of Wisconsin, Madison), R. Minzner (Goddard Space Flight Center), and W. Shenk (Goddard Space Flight Center)

Proc Tenth AMS Conf Severe Local Storms, Omaha, Neb, October 18-21, 1977, pp 495-496

For abstract, see Woiceshyn, P M

KREITER, G. W.

K031 An Investigation of the Side Force that is Sometimes Observed in Rocket Start-Up

J. M. Bowyer, Jr., G. W. Kreiter (Vought Corporation), and R. E. Peterson (University of Arizona)

Preprint 78-1045, AIAA/SAE Fourteenth Joint Propulsion Conf, Las Vegas, Nevada, July 25-27, 1978

For abstract, see Bowyer, J M, Jr

KUDIJA, D. A.

K032 Parametric Study of Two Planar High Power Flexible Solar Array Concepts

J. A. Garba, D. A. Kudija, B. Zeldin, and E. N. Costogoue

JPL Publication 78-95, December 15, 1978

For abstract, see Garba, J A.

KUIPER, E. N. R.

K033 Deuterated Ammonia Toward the Orion Nebula

E. N. R. Kuiper (University of California, Los Angeles), B. Zuckerman (University of Maryland), and T. B. H. Kuiper

Astrophys J, Vol 219, pp L49-L53, January 1, 1978

We observed the two $1_{11}-1_{01}$ rotation-inversion transitions of NH_2D toward the Kleinmann-Low infrared nebula (KL) in Orion. The column density for NH_2D is $\sim 5 \times 10^{13} \text{ cm}^{-2}$, and the abundance ratio $[\text{NH}_2\text{D}]/[\text{NH}_3]$ in this direction is ~ 0.05 . Nondetection of two *E*-type transitions in CH_3OD suggest $[\text{CH}_3\text{OD}]/[\text{CH}_3\text{OH}] < 1/10$ toward KL.

K034 Spectral Line Shapes in Spherically Symmetric Radially Moving Clouds

T. B. H. Kuiper, E. N. R. Kuiper (University of California, Los Angeles), and B. Zuckerman (University of Maryland)

Astrophys J, Vol 219, pp 129-140, January 1, 1978

For abstract, see Kuiper, T B H

KUIPER, T. B. H.

K035 Deuterated Ammonia Toward the Orion Nebula

E. N. R. Kuiper (University of California, Los Angeles), B. Zuckerman (University of Maryland), and T. B. H. Kuiper

Astrophys J, Vol 219, pp L49-L53, January 1, 1978

For abstract, see Kuiper, E N R.

K036 Spectral Line Shapes in Spherically Symmetric Radially Moving Clouds

T. B. H. Kuiper, E. N. R. Kuiper (University of California, Los Angeles), and B. Zuckerman (University of Maryland)

Astrophys J, Vol 219, pp 129-140, January 1, 1978

A method is presented for the analysis of spectral line shapes arising in homogeneous, moving gas clouds in which velocity and molecular line excitation have power-law dependences on radial distance from the center. Analytical expressions are obtained for radial flows, for both optically thick and optically thin lines. The additional case of an optically thick line from a differentially rotating cloud is considered qualitatively. The method is applied to the interpretation of the ^{12}CO line observed in the direction of the Kleinmann-Low infrared nebula in Orion. While gravitational collapse and accelerated outflows would produce lines qualitatively similar to the

observed profile, it does not appear to be possible to fit either model to the observations in detail

K037 Carbon Recombination-Line Mapping of the Orion Nebula

T. B. H. Kuiper and N. J. Evans II (University of Texas, Austin)

Astrophys J, Vol 219, pp 141-147, January 1, 1977

We have mapped the distribution of the C75 α line in the Orion Nebula with a spatial resolution of 13 minutes over a field of view of $\alpha \times \delta = 4 \times 8$ minutes. We find that ionized carbon is more extended than the radio continuum distribution, particularly to the northeast, and possibly also beyond the ionization front in the southeast. However, the emission falls off across the ionization front northwest of the nebula. The emission is generally consistent with a model in which the line is formed in a thin sheet in the molecular cloud immediately adjacent to the HII region. However, the spatial extent of the emission does suggest that some of the emitting gas may be cooler and less dense than has previously been assumed

KUO, Y. S.

K038 Sialons as High Temperature Insulators

W. M. Phillips and Y. S. Kuo

JPL Publication 78-103, December 1, 1978

For abstract, see Phillips, W M

KURTZ, D.

K039 Compilation of Wind Tunnel Coefficients for Parabolic Reflectors

R. Levy and D. Kurtz

JPL Publication 78-16, April 15, 1978

For abstract, see Levy, R.

KURTZ, D. W.

K040 Weight Propagation and Equivalent Horsepower for Alternate-Engined Cars

G. J. Klose and D. W. Kurtz

Preprint 780348, SAE Congress and Exposition, Detroit, Mich, February 27-March 3, 1978

For abstract, see Klose, G J

KUSHIDA, R.

K041 Continuous Extrusion of Coal

C. England, R. Kushida, and C. Daksia

Chem Eng Progr, pp 92-94, August 1978

For abstract, see England, C

LANDEL, R. F.

L001 Strain Energy Function of Styrene Butadiene Rubber and the Effect of Temperature

J. Glucklich and R. F. Landel

J Polym Sci Polym Phys, Vol 15, No 12, pp. 2185-2199, December 1977

For abstract, see Glucklich, J

LANE, A. L.

L002 The Composition of Phobos: Evidence for Carbonaceous Chondrite Surface From Spectral Analysis

K. D. Pang (Planetary Science Institute), J. B. Pollack (Ames Research Center), J. Veverka (Cornell University), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp. 64-66, January 6, 1978

For abstract, see Pang, K. D

L003 Multicolor Observations of Phobos With the Viking Lander Cameras: Evidence for a Carbonaceous Chondritic Composition

J. B. Pollack (Ames Research Center), J. Veverka (Cornell University), K. Pang (Planetary Science Institute), D. Colburn (Ames Research Center), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp 66-69, January 6, 1978

For abstract, see Pollack, J B

LANSING, F. L.

L004 JPL Energy Consumption Program (ECP) Documentation: A Computer Model Simulating Heating, Cooling and Energy Loads in Buildings

F. L. Lansing, V. W. Chai, S. N. Higgins, D. Lascu, R. Urbanajo, and P. Wong

JPL Publication 78-76, September 15, 1978

This engineering manual provides a complete companion documentation about the structure of the main program

and subroutines, the preparation of input data, the interpretation of output results, access and use of the program, and the detailed description of all the analytic, logical expressions and flow charts used in computations and program structure. A numerical example is provided and solved completely to show the sequence of computations followed. The program is carefully structured to reduce both user's time and costs without sacrificing accuracy. The user would expect a cost of CPU time of approximately \$5.00 per building zone excluding printing costs. The accuracy, on the other hand, measured by deviation of simulated consumption from watt-hour meter readings, has been found by many simulation tests not to exceed $\pm 10\%$ margin, a margin which is considered very reasonable for engineering purposes.

L005 Development of a Unified Criterion for Solar Collector Selection

F. L. Lansing

The Deep Space Network Progress Report 42-44
January and February 1978, pp 224-235, April 15, 1978

To assist in making engineering or management decisions, this article explores the possibility of building a single selection criterion to distinguish between different solar collector subsystems for a specific application or between different complete solar-powered systems. The development of two analogous criteria is discussed. The criteria combine both performance and unit area costs, and present the dollar per unit power and the dollar per unit energy produced from a solar plant. Typical values for current focusing and nonfocusing solar collectors were included to support the discussion. The first phase development shows that the criteria evaluation is in need of more data about the annual dynamic behavior of the collector subsystem only, under the transient site-specific parameters such as solar flux, wind, and ambient temperature.

L006 Performance of Solar-Powered Vapor-Jet Refrigeration Systems with Selected Working Fluids

V. W. Chai and F. L. Lansing

The Deep Space Network Progress Report 42-44
January and February 1978, pp 245-251, April 15, 1978

For abstract, see Chai, V. W.

L007 Energy Consumption Program—A Computer Model Simulating Energy Loads in Buildings

F. W. Stoller, F. L. Lansing, V. W. Chai, and S. Higgins

The Deep Space Network Progress Report 42-45
March and April 1978, pp 288-293, June 15, 1978

For abstract, see Stoller, F. W.

LaPORTE, D. D.

L008 Mars: Water Vapor Observations From the Viking Orbiters

C. B. Farmer, D. W. Davies, A. L. Holland, D. D. LaPorte (Santa Barbara Research Center), and P. E. Doms (University of California, Los Angeles)

J. Geophys. Res., Vol 82, No 28, pp 4225-4248, September 30, 1977

For abstract, see Farmer, C. B.

LASCU, D.

L009 JPL Energy Consumption Program (ECP) Documentation: A Computer Model Simulating Heating, Cooling and Energy Loads in Buildings

F. L. Lansing, V. W. Chai, S. N. Higgins, D. Lascu, R. Urbanajo, and P. Wong

JPL Publication 78-76, September 15, 1978

For abstract, see Lansing, F. L.

LAU, E. L.

L010 Tests of General Relativity Using Astrometric and Radio Metric Observations of the Planets

J. D. Anderson, M. S. W. Keesey, E. L. Lau, E. M. Standish, Jr., and X. X. Newhall

Astronautica, Vol 5, pp 43-61, 1978

For abstract, see Anderson, J. D.

LAUDENSLAGER, J. B.

L011 Variable Fragmentation Mass Spectrometry Using Chemi-ionization

J. B. Laudenslager and L. P. Theard

Advances in Mass Spectrometry Proc. Seventh Int. Mass Spectrometry Conf., Florence, Italy, August 30-September 3, 1976, Vol 7B, pp 1388-1393

Penning ionization, or chemi-ionization, is a soft ionization technique which, when applied to analytical mass spectrometry, provides the abilities to simplify a molecular fragmentation pattern and to intensify the molecular

ion peak, identify uniquely geometric isomers which are indistinguishable using high-energy electron impact methods, and identify components in a mixture which cannot be discerned using electron impact or chemical ionization methods alone Penning ionization should have sufficient sensitivity for analytical mass spectrometry

LAVIN, M. L

L012 A Life-Cycle Description of Underground Coal Mining

M. L. Lavin, C. S. Borden, and J. R. Duda

JPL Publication 78-26, April 1978

This paper describes an initial effort to relate the major technological and economic variables which impact conventional underground coal mining systems, in order to help identify promising areas for advanced mining technology The point of departure is a series of investment analyses published by the United States Bureau of Mines, which provide both the analytical framework and guidance on a choice of variables

The result is an algebraic expression for the selling price of clean coal, as a function of labor and capital productivities, required return on investment, average wage rate, equipment availability, initial development cost, recovery factor, tonnage losses due to debris and washing, and similar gross technology descriptors A preliminary investigation of the structure of this price model reveals a hyperbolic dependence on labor and capital productivities and strong sensitivity to required return on investment, productivity of capital and labor, tonnage lost in beneficiation, wages and salaries, and operating supplies

Numerical applications of the pricing model are based on a room and pillar mine in 72-inch coal under 800 feet of overburden, producing 1.5 million tons/year of clean coal Mineral rights are acquired under an option-lease arrangement which requires a minimum annual production payment to the lessor Construction and initial development extend over three years before capacity production is attained Although the model formally requires a fixed amount of equipment and personnel throughout the era of capacity production, an extension shows how to accommodate varying annual production levels

Prepared for the U.S. Department of Energy, FE/9036-1, Distribution Category UC-88

LAWSON, D.

L013 Synthesis and Biological Screening of Novel Hybrid Fluorocarbon Hydrocarbon Compounds for Use as Artificial Blood Substitutes—Annual Report, July 1976–July 1977

J. Moacanin, K. Scherer, A. Toronto (Utah Biological Test Laboratory), D. Lawson, T. Terranova, L. Astle (Utah Biological Test Laboratory), and S. Harvey (Utah Biological Test Laboratory)

JPL Publication 77-80, January 15, 1978

For abstract, see Moacanin, J

LAYLAND, J. W.

L014 Preliminary Design Work on a DSN VLBI Correlator

W. A. Lushbaugh and J. W. Layland

The Deep Space Network Progress Report 42-43 November and December 1977, pp 90-98, February 15, 1978

For abstract, see Lushbaugh, W. A

L015 An Alternate Technique for Near-Sun Ranging

J. W. Layland

The Deep Space Network Progress Report 42-44 January and February 1978, pp 54-62, April 15, 1978

Measurement of the round-trip propagation time to a spacecraft when the signal path passes close by the sun is a severe challenge because of the high noise and time-varying signal delay encountered Scintillation in the solar corona widens the spectrum of the received carrier signal so that it can not be efficiently tracked by the conventional phase locked receivers of the DSN A substantial improvement in performance can be achieved by matching the processing bandwidth to the dynamical conditions of the near-Sun signal path. This processing can be performed off-line with software after the signal is open-loop digitized and recorded This article gives a detailed description and estimates the performance of such a system

L016 On Improved Ranging

J. W. Layland, A. I. Zygielbaum, and W. P. Hubbard

The Deep Space Network Progress Report 42-46 May and June 1978, pp 40-45, August 15, 1978

The currently deployed ranging systems are subject to a variety of waveform distortion errors and equipment vagaries which limit the accuracy of the range data used

for Navigation and Radio Science In light of this fact, this article presents arguments, both subjective and experimental, for increasing the accuracy of the currently deployed ranging system by the adoption of an approximately 1 MHz sine wave for the precision-defining signal for ranging Inferences are also drawn for the design of more precise and wider bandwidth ranging systems in the future

L017 Convolutional Coding Results for the MVM '73 X-Band Telemetry Experiment

J. W. Layland

The Deep Space Network Progress Report 42-48
September and October 1978, pp 18-21,
December 15, 1978

This article presents results of simulation of several short-constraint-length convolutional codes using a noisy symbol stream obtained via the turnaround ranging channels of the MVM'73 spacecraft First operational use of this coding technique is on the Voyager Mission The relative performance of these codes in this environment is as previously predicted from computer-based simulations

LEBERL, F.

L018 Synthetic Aperture Radar Imagery of the AIDJEX Triangle

L. Bryan, T. Farr, F. Leberl, and C. Elachi

AIDJEX Bull, No 37, pp. 161-187,
September 1977

For abstract, see Bryan, L.

LEBOFSKY, L. A.

L019 Identification of Water Frost on Callisto

L. A. Lebofsky

Nature, Vol 269, No 5631, pp 785-787,
October 27, 1977

A description is presented of broadband (J, K, and L) and narrowband (3.0-3.8 μ m) observations of Ganymede and Callisto which were made on the nights of November 7 and November 29, 1976 with a 28-inch infrared telescope Based on the previous identification of water frost on the surface of Ganymede from shorter wavelength data, it is concluded that there is also water frost on the surface of Callisto, taking into account the presence of similar bands for both satellites in the 3-4- μ m spectral range

LeCROISSETTE, D. H.

L020 Final Report: Tissue Identification by Ultrasound

D. H. LeCroissette, R. C. Heyser,
P. M. Gammell, and R. L. Wilson (Harbor General
Hospital, Los Angeles, California)

JPL Publication 78-90, October 15, 1978

A two-year research program has been carried out to measure the ultrasonic properties of animal and human soft tissue over the frequency range of 1.5 to 10.0 MHz The method employed a swept-frequency, coherent technique known as Time Delay Spectrometry Measurements of attenuation versus frequency on liver, backfat, kidney, pancreas, spleen, breast and other tissue were made Considerable attention was paid to tissue handling and in determining the effects of fixing on the attenuation of ultrasound in the tissue

Prepared for the National Science Foundation.

LEE, S.

L021 Synthesis of a Laterally Displaced Cluster Feed for a Reflector Antenna With Application to Multiple Beams and Contoured Patterns

V. Galindo-Israel, S. Lee, and R. Mittra

IEEE Trans Anten Prop, Vol AP-26, No 2, pp
220-228, March 1978

For abstract, see Galindo-Israel, V

LEE, T.

L022 Historical Evidence of Importance to the Industrialization of Flat-Plate Silicon Photovoltaic Systems: Executive Summary

J. L. Smith, W. R. Gates, and T. Lee

JPL Publication 78-36, Vol I, April 1978

For abstract, see Smith, J. L.

L023 Historical Evidence of Importance to the Industrialization of Flat-Plate Silicon Photovoltaic Systems

J. L. Smith, W. R. Gates, and T. Lee

JPL Publication 78-36, Vol II, April 1978

For abstract, see Smith, J. L.

LEEDS, M. W.

L024 A Market Survey of Geothermal Wellhead Power Generation Systems: Final Report

M. W. Leeds and J. Evensizer

JPL Publication 78-29, March 1978

The purpose of this study was to assess the market potential for a portable geothermal wellhead power conversion device (1-10 MW generating capacity). Major study objectives included identifying the most promising applications for such a system, the potential impediments confronting their industrialization, and the various government actions needed to overcome these impediments. The heart of the study was a series of structured interviews with key decision-making individuals in the various disciplines of the geothermal community. In addition, some technical and economic analyses of a candidate system were performed to support the feasibility of the basic concept.

Prepared for the Department of Energy, Division of Geothermal Energy

LEIPOLD, M.

L025 Compatibility Studies of Various Refractory Materials in Contact with Molten Silicon

T. O'Donnell, M. Leipold, and M. Hagan

JPL Publication 78-18, March 1, 1978

For abstract, see O'Donnell, T.

LEIPOLD, M. H.

L026 Structure of Deformed Silicon and Implications for Low Cost Solar Cells

N. Mardesich, M. H. Leipold, G. B. Turner, and T. G. Digges, Jr.

JPL Publication 78-13, March 1, 1978

For abstract, see Mardesich, N

LEISING, C. J.

L027 Utilization of Waste Heat in Trucks for Increased Fuel Economy

C. J. Leising, G. P. Purohit, S. P. DeGrey, and J. G. Finegold

JPL Publication 78-39, May 1, 1978

Trucks currently reject up to 40% of the total fuel energy in the exhaust. Since petroleum costs are continuing to increase, there is growing interest in techniques that can utilize this waste heat to improve overall system efficiency. This report evaluates and compares improvement in fuel economy for a broad spectrum of truck engines and waste heat utilization concepts.

The engines considered are the Diesel, spark ignition, gas turbine, and Stirling. Principal emphasis is placed on the four-stroke Diesel. Because there will be a significant increase in the amount of exhaust energy, the still-to-be-developed "adiabatic" Diesel is also examined.

The waste heat utilization concepts include preheating, regeneration, turbocharging, turbocompounding, and Rankine engine compounding. Predictions are based on fuel-air cycle analyses, computer simulation, and engine test data. All options are evaluated in terms of maximum theoretical improvement, but the Diesel and adiabatic Diesel are also compared on the basis of maximum expected improvement and expected improvement over a driving cycle.

The study indicates that Diesels should be turbocharged and aftercooled to the maximum possible level. At higher boost pressures, the engine power and the fuel economy can be increased, and leaning out the fuel-air mixture or aftercooling the compressor outlet air will reduce the NO_x. Turbocharging also increases the potential for turbocompounding if compressor and turbine efficiencies can be maintained. The results reveal that Diesel driving cycle performance can be increased by 20% through increased turbocharging, turbocompounding, and Rankine engine compounding. The Rankine engine compounding provides about three times as much improvement as turbocompounding but also costs about three times as much. Performance for either can be approximately doubled if applied to an adiabatic Diesel.

Additional results indicate that gas turbine performance can be improved substantially through Rankine engine compounding, but because of a lack of energy in the exhaust, only minimal improvement is possible for the Stirling. Except for regeneration, approximately the same improvement is possible for the spark ignition engine as for the Diesel. Because of higher exhaust temperatures, it would be more efficient to regenerate a spark ignition engine.

Prepared for the Department of Energy

L028 Waste Heat Recovery in Truck Engines

C. J. Leising, G. P. Purohit, S. P. DeGrey, and J. G. Finegold

Preprint 780686, SAE West Coast Meet, San Diego, Calif., August 7-10, 1978

Truck engines currently reject up to 40% of the total fuel energy in the exhaust. Because of increasing petroleum costs, there is growing interest in techniques that can utilize this waste heat to improve overall system efficiency. This paper examines and compares improvement in fuel economy for a broad spectrum of truck engines and waste heat utilization concepts.

The engines considered are the Diesel, spark ignition, gas turbine, and Stirling. Principal emphasis is placed on the turbocharged four-stroke Diesel engine. Because of increased exhaust energy and a large potential improvement in performance, the still-to-be-developed "adiabatic" Diesel is also examined.

The waste heat utilization concepts include preheating, regeneration, turbocharging, turbocompounding, and Rankine engine compounding. Predictions are based on fuel-air cycle analyses, computer simulations, and engine test data. All options are compared on the basis of maximum theoretical improvement. The Diesel and adiabatic Diesel are also evaluated in terms of maximum expected improvement and expected improvement over a driving cycle.

The results indicate that Diesels should be turbocharged and aftercooled to the maximum possible level. Based on current design practices, fuel economy improvements of up to 6% might be possible. It is also revealed that Rankine engine compounding can provide about three times as much improvement in fuel economy as turbocompounding, but perhaps only the same improvement per dollar. By turbocharging, turbocompounding, and Rankine engine compounding, driving cycle performance could be increased by up to 20% for a Diesel and by up to 40% for an adiabatic Diesel. The study also indicates that Rankine engine compounding can provide significant fuel economy improvement for gas turbine and spark ignition engines and regeneration could significantly enhance the performance of spark ignition engines. Because of the low heat content in the exhaust of a Stirling engine, it has only a small potential for further waste heat recovery.

LESH, J. R.

L029 Tracking Loop and Modulation Format Considerations for High Rate Telemetry

J. R. Lesh

The Deep Space Network Progress Report 42-44
January and February 1978, pp 117-124,
April 15, 1978

Tracking loops and modulation formats for DSN telemetry rates in the tens of megasymbols per second region are considered. It is shown that for high rate telemetry, subcarriers should not be used and suppressed carrier modulation should be used. It is then shown that the current DSN receivers can be used for tracking suppressed carrier signals with only minor modifications and that normal doppler tracking operations are unaffected by such changes. Finally, we show that the existing DSN, augmented by a megasymbol telemetry demodulator assembly, can be used to process simultaneous high rate telemetry and ranging signals using an interplex modula-

tion format which results in significant advantages to both telemetry and ranging.

LEU, M. T.

L030 Rate Constant for the Reaction of Atomic Chlorine With Methane

C. L. Lin, M. T. Leu, and W. B. DeMore

J Phys Chem, Vol 82, No 16, pp 1772-1777,
1978

For abstract, see Lin, C. L.

L031 Rate Constant for the Reaction $\text{ClO} + \text{NO} \rightarrow \text{Cl} + \text{NO}_2$

M. T. Leu and W. B. DeMore

J Phys Chem, Vol 82, No 19, pp 2049-2052,
1978

The rate constant for the reaction $\text{ClO} + \text{NO} \rightarrow \text{Cl} + \text{NO}_2$ has been determined over the temperature range 226.7-415.4 K in a discharge flow system using a mass spectrometer as a detector. The results, expressed in the Arrhenius form $k_1 = (5.72 \pm 0.18) \times 10^{-12} \exp[(296 \pm 20)/T] \text{ cm}^3 \text{ s}^{-1}$, are compared with previous measurements.

LEVINTHAL, E. C.

L032 Processing the Viking Lander Camera Data

E. C. Levinthal (Stanford University), W. Green,
K. L. Jones (Brown University), and
R. Tucker (Stanford University)

J Geophys Res, Vol 82, No 28, pp 4412-4420
September 30, 1977

Over 1000 camera events were returned from the two Viking landers during the Primary Mission. A system was devised for processing camera data as they were received, in real time, from the Deep Space Network. This system provided a flexible choice of parameters for three computer-enhanced versions of the data for display or hard-copy generation. Software systems allowed all but 0.3% of the imagery scan lines received on earth to be placed correctly in the camera data record. A second-order processing system was developed which allowed extensive interactive image processing including computer-assisted photogrammetry, a variety of geometric and photometric transformations, mosaicking, and color balancing using six different filtered images of a common scene. These results have been completely cataloged and documented to produce an Experiment Data Record.

LEVY, R.

L033 Compilation of Wind Tunnel Coefficients for Parabolic Reflectors

R. Levy and D. Kurtz

JPL Publication 78-16, April 15, 1978

Wind tunnel data to predict loading on antenna structures is tabulated

L034 LAASP 100-m Antenna Wind Performance Studies

R. Levy and M. S. Katow

The Deep Space Network Progress Report 42-44 January and February 1978, pp 104-113, April 15, 1978

Structural design procedures are described for the LAASP antenna system to meet performance requirements under gravity and wind loading. A computational method is shown for the evaluation of performance in response to wind loading. Cumulative probability distribution curves for wind loading gain reductions for 100-m-diameter antennas are developed to compare a relatively heavy baseline reflector backup structure with two lighter-weight structures, all have equivalent, acceptable performance for gravity loading.

LIEBES, S., JR.

L035 Viking 1975 Mars Lander Interactive Computerized Video Stereophotogrammetry

S. Liebes, Jr. (Stanford University) and A. A. Schwartz

J Geophys Res, Vol 82, No 28, pp 4421-4429, September 30, 1977

A novel computerized interactive video stereophotogrammetry system has been developed for analysis of Viking 1975 lander imaging data. Prompt, accurate, and versatile performance is achieved. Earth-returned digital imagery data are driven from a computer to a pair of video monitors. Powerful computer support enables a photogrammetrist, stereoscopically viewing the video displays, to create diverse topographic products. Profiles, representing the intersection of any definable surface with the Martian relief, are readily generated. Vertical profiles and elevation contour maps, including stereo versions, are produced. Computer overlays of map products on stereo images aid map interpretation and permit independent quality evaluation. Slaved monitors enable parallel viewing. Maps span from the immediate foreground to the remote limits of ranging capability. Surface sampler arm specific vertical profiles enable direct reading of arm commands required for sample acquisition, rock rolling, and trenching. The ranging accu-

racy of ± 2 cm throughout the sample area degrades to ± 20 m at 100-m range.

LIESKE, J. H.

L036 Galilean Satellites: Analysis of Photometric Eclipses

J. H. Lieske

Astron Astrophys, Vol 65, pp 83-92, 1978

The excellent series of photometric eclipses of the Galilean satellites observed at Harvard from 1878 to 1903, which formed the basis for Sampson's study of the Galilean satellites, have been combined with the relatively few available post-1903 photometric eclipse observations in order to evaluate the satellite parameters which occur in the new theory of motion of the satellites. After obtaining values for the ϵ - β parameters, the mutual eclipses and occultations observed in 1973 are compared with the new theory in order to assess the degradation which might occur in the 84 years which have elapsed since the mean epoch of the photometric eclipses. The results indicate that the new theory satisfactorily can predict ephemeris positions of the Galilean satellites over spans of nearly a century and that it will be a useful tool for analyzing future observations.

LIN, C. L.

L037 Ultraviolet Absorption Cross Sections of Hydrogen Peroxide

C. L. Lin, N. K. Rohatgi, and W. B. DeMore

Geophys Res Lett, Vol 5, No 2, pp 113-115, February 1978

The absorption cross sections of hydrogen peroxide vapor in the wavelength range from 195 to 350 nm were determined at 296 K. The absorption cross sections of neutral aqueous solutions of hydrogen peroxide were also measured in the same wavelength range. The results are compared with those of other workers, and calculated photodissociation coefficients of atmospheric hydrogen peroxide are presented.

L038 Rate Constant for the Reaction of Atomic Chlorine With Methane

C. L. Lin, M. T. Leu, and W. B. DeMore

J Phys Chem, Vol 82, No 16, pp 1772-1777, 1978

The rate constant and temperature dependence of the $\text{Cl} + \text{CH}_4$ reaction have been investigated by the techniques of competitive chlorination of $\text{CH}_4/\text{C}_2\text{H}_6$ mixtures and by discharge-flow/mass spectroscopy. The objectives were to determine an accurate value for the rate

constant for use in stratospheric modeling, and to clarify discrepancies in results previously obtained by different techniques. The results deduced from the competitive chlorination study are in good agreement with the absolute values measured by the mass spectrometric method, and at temperatures above 300 K are in good agreement with measurements by other techniques based on resonance fluorescence detection of atomic chlorine. However, in the 220–300 K region, the competitive experiments indicate lower rate constants than those obtained by resonance fluorescence methods, and do not reproduce the curved Arrhenius plots seen in some of those studies.

LIN, R. P.

L039 The Energetic Particle Environment of the Solar Probe Mission—As Estimated by the Participants in the Solar Probe Environment Workshop

M. Neugebauer, L. A. Fisk, R. E. Gold, R. P. Lin, G. Newkirk, J. A. Simpson, and M. A. I. Van Hollebeke

JPL Publication 78-64, September 1, 1978

For abstract, see Neugebauer, M

L040 On a Correlation Between Surface Remanent Magnetism and Chemistry for the Lunar Frontside and Limbs

A. E. Metzger, R. P. Lin (University of California, Berkeley, and C. T. Russell (University of California, Los Angeles)

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14–18, 1977, pp 1187–1190

For abstract, see Metzger, A. E

LING, J. C.

L041 A Search for the Reported 400-keV γ -ray Line From Crab Nebula

J. C. Ling, W. A. Mahoney, J. B. Willett, and A. S. Jacobson

Nature, Vol 270, No 5632, pp 36–37, November 3, 1977

A balloon-borne large volume high resolution γ -ray spectrometer which utilizes 40-cm³ Ge(Li) crystals was used June 10, 1974 to search for a 400-keV γ -ray line from the Crab Nebula. Energy loss spectra in the 400-keV vicinity are compared with γ -ray measurements of the same source which were reported by Leventhal *et al* (1977). In contrast with the 1976 experimental results reported by Leventhal *et al*, a 400-keV line was not

observed. Further, it is thought that the 1974 data contradict the measurement reported by Leventhal *et al* if a constant source intensity is assumed.

LIPES, R. G.

L042 Bandwidth Compression of Synthetic Aperture Radar Imagery by Quantization of Raw Radar Data

R. G. Lipes and S. A. Butman

Proc SPIE, Vol 119, pp 107–114, 1977

Aircraft and spacecraft employing synthetic Aperture Radar (SAR) as a sensor will either have to perform on-board processing before telemetry or directly transmit the raw radar returns back to a ground station for processing. Although complete or partial on-board processing deservedly is receiving careful attention, present technology seems to favor ground station processing requiring extremely high data rates to telemetry the raw radar returns. The usual bandwidth compression strategies utilizing redundancies in the scene being transmitted are inapplicable, however, since the radar returns from even adjacent resolution cells are approximately uncorrelated. Therefore, we turned to quantization of the radar returns to achieve some data rate reduction. In this study, we have investigated the effects of quantization by observing output images after one-bit, two-bit, and eight-bit quantization of the raw radar data. By comparison with the original image (ground truth), we can determine the degradation resulting from data or bandwidth reduction by quantization. Furthermore, the telemetry data rate can also affect output picture quality since transmission errors may be functions of the data rates. To investigate this circumstance, we introduced bit errors with probabilities of 2^{-4} and 2^{-7} . The former being much higher than that expected in "normal" operation, presents a worse case situation, while the latter may be fairly indicative of telemetry links of early space missions using SAR's. We present output images that have been contaminated at these bit error rates.

LIPSIUS, P.

L043 DSS 13 Antenna Subsystem Automation

H. Phillips, I. Crane, and P. Lipsius

The Deep Space Network Progress Report 42-46 May and June 1978, pp 73–75, August 15, 1978

For abstract, see Phillips, H

LIU, A. S.

L044 On the Determination and Investigation of the Terrestrial Ionospheric Refractive Indices Using GEOS-3/ATS-6 Satellite-to-Satellite Tracking Data

A. S. Liu

Radio Sci., Vol 13, No 4, pp 709-716, July-August 1978

When the radio link between two satellites (GEOS-3/ATS-6) is intercepted by the Earth's ionosphere and neutral atmosphere, a change in the Doppler frequency results. Travel through the atmosphere causes the Doppler phase to be advanced in the ionosphere's portion and retarded in the neutral portion of the atmosphere. Analysis of the shortening and lengthening of the phase of the Satellite-to-Satellite Tracking (SST) data that passed within 40-700 km above the Earth's surface during its ATS-6 to GEOS-3 to ATS-6 path, caused by the atmosphere, results in refractivity versus height profiles. The SST Doppler data were used directly to adjust the GEOS-3 orbit. Perturbation from the Moon, Sun, and a 15th-order/degree Earth gravity field were included in the orbit solution. This orbit was continued through the occultation period and a model ionosphere was estimated by a least-squares adjustment of the Chapman ionosphere parameters from the SST data residuals. The refractivity profile obtained by this model ionosphere was compared to a refractivity profile obtained by a direct integral inversion of the SST data residuals. Systematic differences between the two methods were caused by orbital errors, which propagated into the solution. The SST data yielded refractive index profiles in a novel economical manner because no additional or special on-board equipment were required.

LIU, J. K.

L045 Effect of Multiblade Slurry Saw Induced Damage on Silicon Solar Cells

T. Daud, J. K. Liu, G. A. Pollock, and K. M. Koliwad

Conf. Rec. Thirteenth IEEE Photovoltaic Spec. Conf., Washington, D.C., June 5-8, 1978, pp 142-146

For abstract, see Daud, T

LIVERMORE, R. W.

L046 Automated Radio Astronomy Operations

R. W. Livermore

The Deep Space Network Progress Report 42-47 July and August 1978, pp 94-97, October 15, 1978

This article describes improvements in using a computer to drive a DSN 64-meter antenna. The purpose of the development has been to simplify operation, improve antenna safety, reduce antenna wear, prevent the abuse of antenna by mis-operation, increase quantity and qual-

ity of data gathered, and give users a greater choice of automatic operations

LOHMAN, G. M.

L047 A Closed Network Queue Model of Underground Coal Mining Production, Failure, and Repair

G. M. Lohman

JPL Publication 78-72, August 15, 1978

Underground coal mining systems production, failure, and repair cycles were mathematically modeled as a closed network of two queues in series, in order to understand better the technological constraints on availability of current underground mining systems and their associated needs for spares as well as production and maintenance personnel.

Prepared for the Department of Energy

LORDEN, G.

L048 The Role of Interest and Inflation Rates in Life-Cycle Cost Analysis

I. Eisenberger, D. S. Remer, and G. Lorden (California Institute of Technology)

The Deep Space Network Progress Report 42-43 November and December 1977, pp 105-109, February 15, 1978

For abstract, see Eisenberger, I

L049 Economic Evaluation of DSS 13 Unattended Operations Demonstration

D. S. Remer (Harvey Mudd College), I. Eisenberger, and G. Lorden (California Institute of Technology)

The Deep Space Network Progress Report 42-45 March and April 1978, pp 165-171, June 15, 1978

For abstract, see Remer, D. S

LORRE, J. J.

L050 Application of Digital Image Processing Techniques to Astronomical Imagery 1977

J. J. Lorre and D. J. Lynn

JPL Publication 78-17, April 15, 1978

Nine specific techniques or combination of techniques developed by the Image Processing Laboratory of the Jet Propulsion Laboratory for applying digital image processing technology to existing astronomical imagery

are described. They are 1) the development of automated object location, intensity, and cataloging algorithms, 2) the computation, generation and display of polarization information from image data, 3) the use of principal component transformations to segregate and display color structure and to compute optimally weighted intensity images, 4) the use of enhancement in the color domain to exaggerate and display small spectral differences, 5) the use of pseudo-color to identify and discriminate between regions having differing characteristics, 6) the use of non-linear spatial filtering techniques to extract and display only that structure lying within a desired size domain, 7) the deconvolution of atmosphere and instrument optical transfer functions from an image in order to achieve a moderate increase in resolution, 8) the use of texture maps and isophote contours to detect and display very subtle structural characteristics, 9) the use of multispectral classification techniques to combine and correlate observations taken at various wavelengths.

Photoproducts are included to illustrate the results of each of these investigations.

L051 Application of Digital Image Processing Techniques to Astronomical Imagery 1978

J. J. Lorre

JPL Publication 78-91, November 1, 1978

Several areas of application of image processing to astronomy have been identified and developed in this report. These areas include (1) geometric and radiometric decalibration of vidicon-acquired spectra, (2) automatic identification and segregation of stars from galaxies, and (3) display of multiband radio maps in compact and meaningful formats. Examples are presented of these techniques applied to a variety of objects. The techniques were developed at the Image Processing Laboratory of the Jet Propulsion Laboratory.

L052 Enhancement of the Jets in NGC 1097

J. J. Lorre

Astrophys J, Vol 222, pp L99-L103, June 15, 1978

Plates of NGC 1097 taken in four spectral bands by H. Arp have been digitized and processed at JPL's Image Processing Laboratory. The processing has revealed (1) that there is a fourth jet, R4, counter to the L-shaped jet, R1, (2) that the area density of point sources in the jets is no different from that found on the sky, (3) that two of the jets, R1 and R2, are bluer than the night sky, while one of the jets, R3, is redder than the night sky, (4) that the nonstellar objects situated on the jets are noticeably bluer than the night sky, and (5) that color-enhanced images of the spiral structure illustrate the distribution of both gaseous and spiral-arm stellar population dis-

rupted from symmetry by an apparent companion elliptical.

L053 IPL Processing of the Viking Orbiter Images of Mars

R. M. Ruiz, D. A. Elliott, G. M. Yagi, R. B. Pomphrey, M. A. Power, K. W. Farrell, Jr., J. J. Lorre, W. D. Benton, R. E. Dewar, and L. E. Cullen

J Geophys Res, Vol 82, No 28, pp 4189-4202, September 30, 1977

For abstract, see Ruiz, R. M.

LUDWIG, A. C.

L054 A Transform-Pair Relationship Between Incident and Scattered Fields from an Arbitrary Reflector

A. C. Ludwig (Technical University of Denmark, Lyngby, Denmark) and S. A. Brunstein

Radio Sci, Vol 13, No 5, pp 785-788, September-October 1978

It is shown that a transform-pair relationship exists between incident and scattered fields from an infinite, perfectly conducting reflector of arbitrary shape, when the physical optics approximation is applied. As an example of potential applications, this relationship is used to synthesize a reflector feed pattern required to produce a desired far-field pattern from a given paraboloidal reflector.

LUSHBAUGH, W. A.

L055 Preliminary Design Work on a DSN VLBI Correlator

W. A. Lushbaugh and J. W. Layland

The Deep Space Network Progress Report 42-43, November and December 1977, pp 90-98, February 15, 1978

The DSN is in the process of fielding high-density digital instrumentation recorders for support of the Pioneer Venus 1978 Entry Experiment and other related tasks. It has long been obvious that these recorders would also serve well as the recording medium for VLBI experiments with relatively weak radio sources, provided that a suitable correlation processor for these tape recordings could be established. This article describes the overall design and current status of a VLBI correlator designed to mate with these tape recorders.

LUTES, G. F.

L056 Stable Low Noise Voltage Source

G. F. Lutes

The Deep Space Network Progress Report 42-47, July and August 1978, pp 89-93, October 15, 1978

Hum and noise on power sources can have a significant effect on system noise, and because it is predominately low frequency, 60 or 120 Hz, it is extremely difficult to reduce to levels in the order of $1 \mu\text{V}/\text{Hz}^{1/2}$, particularly at high current levels. Filtering to achieve low hum and noise is best accomplished at low current levels and should therefore be done locally. The diode regulator circuit described in this article is nearly ideal for this type of local filtering.

LYNN, D. J.

L057 Application of Digital Image Processing Techniques to Astronomical Imagery 1977

J. J. Lorre and D. J. Lynn

JPL Publication 78-17, April 15, 1978

For abstract, see Lorre, J. J.

LYON, R. B.

L058 A Method for Measuring Group Time Delay Through a Feed Horn

T. Y. Otoshi, R. B. Lyon, and M. Franco

The Deep Space Network Progress Report 42-44 January and February 1978, pp 82-89, April 15, 1978

For abstract, see Otoshi, T. Y.

LYTTLETON, R. A.

L059 Effect of a Changing G on the Moment of Inertia of the Earth

R. A. Lyttleton and J. P. Fitch (Institute of Astronomy, Cambridge, England)

Astrophys J, Vol 221, pp 412-413, April 15, 1978

A recent value found by Nordtvedt and Will for the rate of increase of the moment of inertia of the Earth resulting from a decreasing G is shown to be based on conflicting physical assumptions. The corrected result for this restricted problem yields a rate of change almost twice as large. However, in a realistic treatment, additional purely geophysical causes must also be taken into account, and these imply a decreasing moment of inertia on a scale much outweighing the increase that would occur on any acceptable value of the rate of change of

G . This accords with the intrinsic acceleration of angular velocity established from the ancient-eclipse data.

L060 On the Accelerations of the Moon and Sun, the Constant of Gravitation, and the Origin of Mountains

R. A. Lyttleton and J. P. Fitch (Institute of Astronomy, Cambridge, England)

Moon and Planets, Vol. 18, pp 223-240, 1978

In a previous paper Lyttleton (1976) has shown that the apparent secular accelerations of the Sun and Moon, as given by de Sitter, can be largely explained if the Earth is contracting at the rate required by the phase-change hypothesis for the nature of the core. More reliable values for these accelerations have since become available which warrant a redetermination of the various effects concerned on the basis of constant G , and this is first carried out in the present paper. The lunar tidal couple, which is the same whether G is changing or not, is found to be $(4.74 \pm 0.38) \times 10^{23}$ cgs, about three-quarters that yielded by the de Sitter values, while within the theory the Moon would take correspondingly longer to reach close proximity to the Earth at about 1.5×10^9 years ago.

The more accurate values of the accelerations enable examinations to be made of the effects that a decreasing G would have, and it is shown that a value $\dot{G}/G = -3 \times 10^{-11} \text{ yr}^{-1}$ can be weakly satisfied compared with the close agreement found on the basis of constant G , while a value as large numerically as $\dot{G}/G = -6 \times 10^{-11} \text{ yr}^{-1}$ seems to be definitely ruled out. On the iron-core model, an intrinsic positive component of acceleration of the angular velocity cannot be reconciled at all with the secular accelerations even for constant G , and far less so if G is decreasing at a rate suggested by any recent cosmological theory.

If $\dot{G} = 0$, the amount of contraction available for mountain-building would correspond to a reduction of surface area of about $49 \times 10^6 \text{ km}^2$ and a volume to be redistributed of $160 \times 10^9 \text{ km}^3$ if the time of collapse were 2.5×10^9 years ago. For earlier times, the values are only slightly reduced. If $\dot{G}/G = -3 \times 10^{-11} \text{ yr}^{-1}$, the corresponding values are $44 \times 10^6 \text{ km}^2$ and $138 \times 10^9 \text{ km}^3$ for collapse at $-2.5 \times 10^9 \text{ yr}$, and not importantly smaller at $38 \times 10^6 \text{ km}^2$ and $122 \times 10^9 \text{ km}^3$ for collapse at $-4.5 \times 10^9 \text{ yr}$. Any of these values would suffice to account in order of magnitude for all the eras of mountain-building. An intense brief period of mountain-building on an immense scale would result from the Ramsey-collapse at whatever time past it may have occurred.

MADRID, G. A.

M001 Application of Kalman Filtering to Spacecraft Range Residual Prediction

G. A. Madrid and G. J. Bierman

IEEE Trans Automat Contr, Vol AC-23, No 3, pp 430-433, June 1978

One function of the Deep Space Network is validation of the range data that they receive. In this short paper we present an automated online sequential range predictor which shows promise of significantly reducing computational and manpower expenditures. The proposed algorithm, a U - D covariance factored Kalman filter, is demonstrated by processing a four month record of Viking spacecraft data taken en route to Mars.

MADURA, D. P.

M002 Evaluation of Landsat MSS vs TM Simulated Data for Distinguishing "Hydrothermal Alteration"

M. J. Abrams, A. B. Kahle, D. P. Madura, and J. M. Soha

JPL Publication 77-83, March 1, 1978

For abstract, see Abrams, M. J.

MAHONEY, W. A.

M003 A Search for the Reported 400-keV γ -ray Line From Crab Nebula

J. C. Ling, W. A. Mahoney, J. B. Willett, and A. S. Jacobson

Nature, Vol. 270, No 5632, pp 36-37, November 3, 1977

For abstract, see Ling, J. C.

MAIOCCO, F. R.

M004 An Effective Procurement and Financial Management Reporting System

J. B. Rozek and F. R. Maiocco

The Deep Space Network Progress Report 42-44 January and February 1978, pp 289-310, April 15, 1978

For abstract, see Rozek, J. B.

MALIN, M. C.

M005 Modification of Fresh Crater Landforms: Evidence From the Moon and Mercury

M. C. Malin and D. Dzurisin (California Institute of Technology)

J Geophys Res, Vol 83, No B1, pp 233-243, January 10, 1978

The morphology of fresh lunar and mercurian craters provides insight into processes of crater formation and modification. Measurements determined for mercurian craters and compared to previously presented lunar data are depth/diameter, central peak and wall-related mass movement frequencies as functions of diameter, crater rim wall width/rim diameter, rim diameter/floor diameter, and central peak height/rim diameter. Two important results are as follows: (1) there is no evidence for direct gravity scaling of crater morphology, although some slight ($\sim g^{1/4}$ to $g^{1/8}$) scaling relationship may be indicated, and (2) mass movements are responsible for the change in depth/diameter relationship observed near 2-km depth and 10-km diameter. The latter result is helpful in explaining gravitational and topographic data which suggest low-density regions beneath large, fresh craters.

M006 Venus: Geologic Analysis of Radar Images

R. S. Saunders and M. C. Malin

Proc Int Colloq Planet Geol, Rome, Italy, September 22-30, 1975, pp 507-515

For abstract, see Saunders, R. S.

MALLEN, W.

M007 Ionizing Radiation Effects on SBP9900 Microprocessor

A. G. Stanley, W. Mallen, and P. Springer

IEEE Trans Nucl Sci, Vol NS-24, No 4, pp 1977-1978, August 1977

For abstract, see Stanley, A. G.

MANCINI, R. A.

M008 CCM Implementation Status

R. A. Mancini

The Deep Space Network Progress Report 42-45 March and April 1978, pp 276-281, June 15, 1978

Intensive activity has been invested in the preparation of planning the Control and Computational Module (CCM) implementation into the DSN. A de facto standard has evolved from work performed by the Communications Systems Research Section. The DSN Data Systems Section is currently coordinating the total effort involved.

with the CCM implementation. Part of this effort is the selection of a Standard CCM family. A CCM Selection Recommendation Committee has been formed of representatives of the Telecommunications Science and Engineering Division and the DSN Engineering Section. A support CCM Policy Committee has also been formed of broad representation to develop policies to govern use of CCMs in DSN application. Every effort is being taken toward the establishing and support of a CCM Standard family for use in designing and implementing applicable equipment for the DSN.

MARDESICH, N.

M009 Structure of Deformed Silicon and Implications for Low Cost Solar Cells

N. Mardesich, M. H. Leipold, G. B. Turner, and T. G. Digges, Jr.

JPL Publication 78-13, March 1, 1978

The microstructure and minority carrier lifetime of silicon were investigated in uniaxially compressed silicon samples. The objective of the investigation was to determine if it is feasible to produce silicon solar cells from sheet formed by high temperature rolling. The initial structure of the silicon samples ranged from single crystal to fine-grained polycrystals. The samples had been deformed at strain rates of 0.1 to 8.5 sec⁻¹ and temperatures of 1270–1380°C with subsequent annealing at 1270–1380°C.

Recrystallization was incomplete even after long anneals. A 10 hour anneal of fine-grained samples with as much as 51% strain only caused 95% of the samples to recrystallize and even then the recrystallized grains contained twin boundaries and dislocations. The recrystallization in the large grained samples was also incomplete and further, it has been shown that large grained material cracks readily during significant deformation (up to 40%). The major mode of recrystallization appears to be migration of existing boundaries into the deformed regions. Minority carrier diffusion length was drastically reduced by deformation and recovered only slightly with annealing. These results suggest that high temperature rolling of silicon to produce sheet for solar cells of high efficiency is not practical.

Prepared for the Department of Energy, DOE/JPL-1012-78/3, Distribution Category UC-63

MARGOLIS, J. S.

M010 Bandstrength Determination of the Fundamental Vibration-Rotation Spectrum of ClO

J. S. Margolis, R. T. Menzies, and E. D. Hinkley

Appl Opt, Vol 17, No 11, pp 1680–1682, June 1, 1978

The fundamental vibration-rotation spectrum of ClO is examined with the objective of determining the fundamental absorption strengths of the lines. This was accomplished using sensitive derivative spectroscopy methods which involved calibration through direct measurements of NH₃ absorption lines. In addition, improved measurements of selected line frequencies were obtained by a laser heterodyne technique. These measurements, along with results from a recent study of ClO by researchers at the NASA Langley Research Center, were used to estimate new positions for the band centers of the $\Omega = 3/2$ and $\Omega = 1/2$ states.

M011 Intensity and Pressure Shift of the H₂ (4,0) S(1) Quadrupole Line

J. T. Bergstralh, J. S. Margolis, and J. W. Brault (Kitt Peak National Observatory)

Astrophys J, Vol 224, pp. L39–L41, August 15, 1978

For abstract, see Bergstralh, J. T.

M012 Absorption Strength of the Perturbed ν_4 Band of CH₃Cl

J. S. Margolis

J Mol Spectros, Vol 70, No 2, pp 257–262, May 1978

The ν_4 band of CH₃Cl interacts strongly with the $3\nu_6$ band. Levels of both bands are mixed and both appear strongly in absorption. The strengths of both bands have been measured taking into account the mixing of the levels. The absorption strengths of both bands can be related to a single parameter, namely, the strength of the unperturbed ν_4 band. This was calculated to be 41.8 cm⁻² atm⁻¹ at 297 K.

MARTIN, K. E.

M013 Voyager Electronic Parts Radiation Program Test Requirements and Procedures

A. G. Stanley, K. E. Martin, and W. E. Price

JPL Publication 77-41, Vol II, December 15, 1978

For abstract, see Stanley, A. G.

MARTIN, M.

M014 DSN System Performance Test Software

M. Martin

The Deep Space Network Progress Report 42-43
November and December 1977, pp 224-227,
February 15, 1978

The Deep Space Network Operations Software Support Group has developed an entirely new, fully automated means of testing the performance of the Deep Space Station Data Subsystems. The DSN System Performance Test Software was developed for the new DSN Mark-III '77 Data System (MDS)

MASSIER, P. F.

M015 Influence of Internally Generated Pure Tones on the Broadband Noise Radiated from a Jet

S. P. Parthasarathy, R. Cuffel, and P. F. Massier
AIAA J, Vol 16, No 5, pp 538-540, May 1978

For abstract, see Parthasarathy, S P

MASSOUDI, M.

M016 Tracking Error of 100-m Antenna due to Wind Gust
M. Massoudi

The Deep Space Network Progress Report 42-48
September and October 1978, pp 94-101,
December 15, 1978

A procedure is shown to derive root-mean-square tracking error for an antenna system in response to wind-gust loading. Example calculations are illustrated for the design of a proposed 100-m antenna. The effect of wind-gust correlation is also considered

MATSON, D. L.

M017 Visual and Infrared Photometry of Asteroids

G. J. Veeder, D. L. Matson, and J. C. Smith

Astron J, Vol 83, No 6, pp 651-663,
June 1978

For abstract, see Veeder, G J

M018 Sodium D-Line Emission From Io: Comparison of Observed and Theoretical Line Profiles

R. W. Carlson, D. L. Matson, T. V. Johnson, and J. T. Bergstralh

Astrophys J, Vol 223, pp 1082-1086, August 1, 1978

For abstract, see Carlson, R. W

M019 Soil Maturity and Planetary Regoliths: The Moon, Mercury, and the Asteroids

D. L. Matson, T. V. Johnson, and G. V. Veeder

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 1001-1011

Observations of the Moon, Mercury and the asteroids provide data which can be used to assess current ideas about the optical maturation of regoliths of bodies without atmospheres. Telescopic data show Mercury's surface to be as optically mature as the Moon's while the asteroids appear to have "fresh" surfaces. We suggest that these cases illustrate two different paths of regolith evolution caused by differing micrometeoroid impact velocities, gravity, and in some cases composition

M020 Lunar Spectral Units: A Northern Hemispheric Mosaic

T. V. Johnson, J. A. Mosher, and D. L. Matson

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 1013-1028

For abstract, see Johnson, T V

M021 A TiO₂ Abundance Map for the Northern Maria

T. V. Johnson, R. S. Saunders,
D. L. Matson, and J. A. Mosher

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 1029-1036

For abstract, see Johnson, T V

M022 Asteroids and Comparative Planetology

D. L. Matson, F. P. Fanale, T. V. Johnson, and G. J. Veeder

Proc Seventh Lunar Sci Conf, Houston, Tex, March 15-19, 1976, pp 3603-3627

The state of knowledge concerning the asteroids is reviewed and discussed in terms of the relationship of the asteroids with other solar system bodies. The data on spectral reflectances of asteroids are examined, and their implications for comparative planetology are discussed

M023 Images of Io's Sodium Cloud

D. L. Matson, B. A. Goldberg, T. V. Johnson, and R. W. Carlson

Science, Vol 199, pp 531-533, February 3, 1978

The first direct images of Io's sodium cloud are reported and analyzed. The observed cloud extends for more than 10⁵ kilometers along Io's orbit and is a somewhat "banana-shaped" partial toroid. More sodium atoms precede Io than follow it. A model based on the escape of sodium from a specific localized area on Io provides a reasonable

fit to the observed intensity distribution whereas isotropic escape does not

McDANELL, J. P.

M024 Mission Applications of the Dual Spacecraft Tracking Technique

C. C. Chao and J. P. McDanell

The Deep Space Network Progress Report 42-43
November and December 1977, pp 82-89,
February 15, 1978

For abstract, see Chao, C C

McELIECE, R. J.

M025 An Analysis of Alternate Symbol Inversion for Improved Symbol Synchronization in Convolutionally Coded Systems

L. D. Baumert, R. J. McEliece, and
H. van Tilborg (Technological University,
Netherlands)

The Deep Space Network Progress Report 42-44
January and February 1978, pp 90-97, April 15,
1978

For abstract, see Baumert, L D

M026 A Public-Key Cryptosystem Based on Algebraic Coding Theory

R. J. McEliece

The Deep Space Network Progress Report 42-44
January and February 1978, pp 114-116,
April 15, 1978

Using the fact that a fast decoding algorithm exists for a general Goppa code, while none exists for a general linear code, we construct a public-key cryptosystem which appears quite secure while at the same time allowing extremely rapid data rates. This kind of cryptosystem is ideal for use in multi-user communication networks, such as those envisioned by NASA for the distribution of space-acquired data.

M027 The Lovasz Bound and Some Generalizations

R. J. McEliece, E. R. Rodemich, and
H. C. Rumsey, Jr.

The Deep Space Network Progress Report 42-45
March and April 1978, pp 133-146, June 15,
1978

In 1956, Shannon defined the zero-error capacity of a discrete memoryless channel as the largest rate at which information can be transmitted over the channel with

zero error probability. He exhibited one particularly interesting channel with five inputs and outputs whose zero error capacity he could not compute. The problem of computing this capacity remained unsolved until very recently, when Lovasz computed it in an astonishing simple manner. We show that Lovasz' ideas, combined with some of our own, lead to an extremely powerful and general technique, which we phrase in terms of graph theory, for studying combinatorial packing problems. In particular, Delsarte's linear programming bound for cliques in association schemes appear as a special case of the Lovasz bound.

M028 A Probabilistic Version of Sperner's Theorem, With Applications to the Problem of Retrieving Information From a Data Base

L. D. Baumert, R. J. McEliece,
E. R. Rodemich, and H. Rumsey, Jr.

The Deep Space Network Progress Report 42-46
May and June 1978, pp 81-86, August 15, 1978

For abstract, see Baumert, L D

M029 Soft Decision Decoding of Block Codes

L. D. Baumert and R. J. McEliece

The Deep Space Network Progress Report 42-47
July and August 1978, pp. 60-64, October 15,
1978

For abstract, see Baumert, L D

M030 On the Inherent Intractability of Certain Coding Problems

E. R. Berlekamp (University of California,
Berkeley), R. J. McEliece, and
H. C. A. van Tilborg (Technological University of
Eindhoven, Netherlands)

IEEE Trans Inform Theor, Vol IT-24, No 3, pp.
384-386, May 1978

For abstract, see Berlekamp, E R.

M031 A Property of Euclid's Algorithm and an Application to Pade Approximation

R. J. McEliece and J. B. Shearer

SIAM J Appl Math, Vol 34, No 4, pp 611-615,
June 1978

If a and b are fixed polynomials with $\deg(a) > \deg(b)$, we show that all solutions to the congruence $q \equiv p \pmod{a}$ with $\deg(q) + \deg(p) < \deg(a)$ can be obtained via Euclid's algorithm. Using this result, we show that the Pade approximants to a given power series can also be obtained from Euclid's algorithm.

McGINNESS, H.

M032 Analysis of a Suspension System for a Wheel Rolling on a Flat Track

H. McGinness

JPL Publication 78-43, August 1, 1978

A flexure strut wheel suspension system is described which keeps a wheel flat against the track and maintains a small interface moment. Equations are presented for the evaluation of this moment. A comparison of the flexure strut system is made with a rigid link design containing pivot bearings.

M033 Lateral Forces Induced by a Misaligned Roller

H. McGinness

The Deep Space Network Progress Report 42-45
March and April 1978, pp 253-257, June 15, 1978

The magnitude of the lateral force induced by a roller, misaligned in its direction of travel, can be large and is not linearly proportional to the misalignment.

McKENZIE, M.

M034 Evaluation of the Developing DSN Life-Cycle Cost Standard Practice

M. McKenzie

The Deep Space Network Progress Report 42-46
May and June 1978, pp 139-145, August 15, 1978

The DSN is developing a Life-Cycle Cost Standard Practice. This report compares the developing Practice to those of industry and the Department of Defense. Results show that the DSN uses the accepted concept of Life-Cycle Costing, tailoring the concept to DSN specific needs, but does not push the concept past the point of prevailing theory.

M035 Evaluation of the DSN Software Methodology

A. Irvine and M. McKenzie

The Deep Space Network Progress Report 42-48
September and October 1978, pp 72-81, December 15, 1978

For abstract, see Irvine, A.

McLAUGHLIN, W. I.

M036 Infrared Astronomical Satellite

W. I. McLaughlin and W. H. de Leeuw (Fokker-VFW, Netherlands)

Spaceflight, Vol 20, pp 187-191, May 1978

Design and mission characteristics of the Infrared Astronomical Satellite (IRAS) are reviewed with attention to the satellite/telescope configuration. The IRAS will be launched into a 900-km near-polar orbit (inclination 99 deg), with a cryogenically cooled 60-cm telescope capable of collecting 700 million bits of data per day. The telescope is expected to add from 6000 to one million new IR sources to the astronomical catalogs. Objects for study include stars, extended sources, asteroids, zodiacal light, artificial satellites, high energy protons, and dust.

MEHTA, J.

M037 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography: Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle, E. Christensen, D. Farless, J. Mehta, B. Seidel, W. Michael, Jr. (Langley Research Center), A. Wallio (Langley Research Center), and M. Grossi (Raytheon Company)

J Geophys Res, Vol 82, No 28, pp 4317-4324, September 30, 1977

For abstract, see Fjeldbo, G.

MEHTA, J. S.

M038 System Performance Testing of the DSN Radio Science System, Mark III-78

A. L. Berman and J. S. Mehta

The Deep Space Network Progress Report 42-43
November and December 1977, pp 129-133, February 15, 1978

For abstract, see Berman, A. L.

MENZIES, R. T.

M039 Bandstrength Determination of the Fundamental Vibration-Rotation Spectrum of ClO

J. S. Margolis, R. T. Menzies, and E. D. Hinkley

Appl Opt, Vol 17, No 11, pp 1680-1682, June 1, 1978

For abstract, see Margolis, J. S.

M040 The Airborne Laser Absorption Spectrometer: A New Instrument for Remote Measurement of Atmospheric Trace Gases

M. S. Shumate and R. T. Menzies

Fourth Joint Conf Sensing of Environ Pollutants
Conf Proc, New Orleans, La, November 6-11,
1977, pp 420-422

For abstract, see Shumate, M S

M041 Tropospheric Ozone Distributions Measured With an Airborne Laser Absorption Spectrometer

R. T. Menzies and M. S. Shumate

J Geophys Res, Vol 83, No C8, pp. 4039-4043,
August 20, 1978

Measurements of tropospheric ozone have been made in the southern and middle California regions and over the Pacific Ocean during two series of flights in February and May 1977. The data were obtained by using a laser absorption spectrometer, a nadir-viewing instrument which remotely measures the ozone column abundance between ground level and aircraft altitude by interacting with ozone at specific wavelengths near $9.5 \mu\text{m}$. The measurements indicate significantly lower ozone abundances above the Mojave Desert region as compared with farm, forest, and urban areas. The average tropospheric column density was found to be 2.7×10^{-3} atm cm/km over the California region and 3.5×10^{-3} atm cm/km over the Pacific Ocean region 1000-2000 km west of the coast of Mexico.

M042 Atmospheric Monitoring Using Heterodyne Detection Techniques

R. T. Menzies

Opt Eng, Vol 17, No 1, pp 44-49, January-February 1978

Both passive and active remote monitoring instruments, using discretely tunable infrared gas lasers and heterodyne receivers, have been used for measurements of ozone and other trace constituents in the atmosphere. A ground-based, solar heterodyne radiometer has been used in discrete spectral regions near $9.5 \mu\text{m}$ to measure altitude profiles of ozone in both the troposphere and stratosphere. Results indicate that this technique shows promise in providing calibration points for earth orbiting ozone measurement instruments. An airborne laser absorption spectrometer has been used to measure tropospheric ozone in two series of flights during the winter and spring of 1977, and these operations will be described here. Plans are also in progress to fly a balloon-borne heterodyne radiometer during the fall of 1977 in order to measure stratospheric trace species.

METCALFE, M. A.

M043 A Survey of Electric and Hybrid Vehicle Simulation Programs: Final Report

J. Bevan, D. A. Heimburger, and M. A. Metcalfe
JPL Publication 78-58, Vol 1, July 1, 1978

For abstract, see Bevan, J

METZGER, A. E.

M044 Thorium Concentrations in the Lunar Surface. I: Regional Values and Crustal Content

A. E. Metzger, E. L. Haines, R. E. Parker, and
R. G. Radocinski

Proc Eighth Lunar Sci Conf Houston, Tex, March 14-18, 1977, pp 949-999

New techniques based on energy band analysis and photopeak analysis have been applied to the orbital gamma-ray data from Apollo in conjunction with prior results to yield thorium concentrations of increased sensitivity and more detailed coverage. Results for 144 lunar regions are presented together with their associated uncertainties. The zone of lowest radioactivity thus far observed on the moon is located in the western hemisphere close to the limb with a thorium concentration below 0.3 ppm. Radioactivity in eastern limb regions averages twice that of corresponding western limb regions but shows less contrast. Significant variations are seen in the farside highlands including a dramatic discontinuity near 180° which is shown to match differences in elevation. This correlation between radioactivity and elevation is traced back to crustal thickness and a relationship has been found between thorium concentration and crustal thickness in the highlands. The thicker crustal regions contain less thorium in a nearly inverse relation. This suggests a simple concentration model for thorium in the highland crust derived from an initially molten outer zone. A major consequence of the relationship is that highland areas have retained the primary crustal imprint on their surfaces through the subsequent intense bombardment. Variations in crustal thickness explain the farside highland asymmetry previously noted for thorium and iron.

Broader chemical boundaries of the backside feature near Van de Graaff have been recognized and now match those defined for the massive magnetic region co-located here. Tsiolkovsky is interpreted as filled by mare basalts similar to those found at Apollo 17. Measurements over the landing sites include a value of 1.4 ppm thorium for the region sampled by Luna 24 and suggest that Apollo 15 returned a representative sampling of the local material on a scale of 100-200 km while Luna 16 did not. Orbital K/Th ratios decrease continuously with increasing thorium and are shown to be in good agreement with sampled site averages. Applying mean values of the thorium and potassium content in major chemical provinces to the entire lunar surface yields estimates of 1.3 ppm thorium and $\text{K/U} = 2100$ if maria regions are included, and 0.91 ppm thorium and $\text{K/U} = 2400$ for a

highland surface only. The latter pair of values also characterizes the lunar crust if these elements are distributed uniformly with depth in a uniform crust. Taking variations of crustal thickness into account, the Th content of the measured highland regions is calculated as 0.63 ppm, while an estimate of the average crustal concentration of the entire moon gives 0.80 ppm.

Details of the error analysis and our lunar regional catalog are included as appendices.

M045 On a Correlation Between Surface Remanent Magnetism and Chemistry for the Lunar Frontside and Limbs

A. E. Metzger, R. P. Lin (University of California, Berkeley), and C. T. Russell (University of California, Los Angeles)

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 1187-1190

Image-processing techniques applied to orbital data have revealed an inverse correlation between lunar surface remanent magnetism and surface concentrations of Fe and Th on a scale of 250 km and greater. The effect can be understood in terms of the implantation of magnetism early in the history of the moon, coupled with the chronological sequence of highland-mare crustal differentiation. The exception seen at the Fra Mauro region suggests the presence of a source of magnetization sometime within 0.3-0.6 by after formation of the moon.

MICHAEL, W., JR.

M046 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography: Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle, E. Christensen, D. Farless, J. Mehta, B. Seidel, W. Michael, Jr. (Langley Research Center), A. Wallio (Langley Research Center), and M. Grossi (Raytheon Company)

J Geophys Res, Vol 82, No 28, pp 4317-4324, September 30, 1977

For abstract, see Fjeldbo, G

MILLER, R.

M047 A Game With n Numbers

R. Miller

Amer Math Mon, Vol 85, No 3, pp 183-185, March 1978

This paper starts with a sequence of n integers a_1, a_2, \dots, a_n , and forms their absolute differences, $|a_1 - a_2|$,

$|a_2 - a_3|, \dots, |a_{n-1} - a_n|$. It then iterates this transformation S , and asks whether the sequence $0, 0, \dots, 0$ must always be reached. It shows that the answer is affirmative if and only if n is a power of 2.

M048 Codes Arising From Non-Abelian Group Algebras

R. Miller

Proc 1978 Conf Inform Sci Syst, The Johns Hopkins University, Baltimore, Maryland, March 29-31, 1978, pp 514-517

In this paper, we investigate codes arising from non-abelian group algebras. This class of codes thus far has received almost no attention. We begin with a brief review of representation theory and continue by characterizing all weight-preserving automorphisms of a group algebra. We then determine the weight distributions of all minimal left ideals in the group algebra $F_q[S_3]$, where S_3 is the symmetric group on three symbols, and $(q, 6) = 1$. Finally we note that the weight distribution of a minimal left ideal need not determine the ideal up to a weight-preserving automorphism. (However if G is an abelian group of odd order and $q = 2$, then two minimal ideals m_1 and m_2 have the same weight distribution if and only if there exists an automorphism $\psi \in \text{Aut } G$ such that $\psi(m_1) = m_2$.)

MILLER, R. B.

M049 Pioneer Venus 1978 Mission Support

R. B. Miller

The Deep Space Network Progress Report 42-45 March and April 1978, pp 35-38, June 15, 1978

The Tracking and Data System and Deep Space Network preparation and support activities for the Pioneer Venus 1978 Mission are described for the period from June 3, 1977 to April 24, 1978.

M050 Pioneer 10 and 11 Mission Support

R. B. Miller

The Deep Space Network Progress Report 42-47 July and August 1978, pp 21-25, October 15, 1978

The current estimates of the Deep Space Network performance capability in tracking Pioneer 10 to the telecommunications limit and for Pioneer 11 Saturn encounter are discussed.

MILLER, R. L.

M051 A New Algorithm for Computing Primitive Elements in $GF(q^2)$

I. S. Reed (University of Southern California),
T. K. Truong, and R. L. Miller

The Deep Space Network Progress Report 42-45
March and April 1978, pp 190-196, June 15,
1978

For abstract, see Reed, I. S.

M052 Necklaces, Symmetries and Self-Reciprocal Polynomials

R. L. Miller

Discrete Math, Vol 22, pp 25-33, 1978

The connection between a certain class of necklaces and self-reciprocal polynomials over finite fields is shown. For $n \geq 2$, self-reciprocal polynomials of degree $2n$ arising from monic irreducible polynomials of degree n are shown to be either irreducible or the product of two irreducible factors which are necessarily reciprocal polynomials. Using DeBruijn's method we count the number of necklaces in this class and hence obtain a formula for the number of irreducible self-reciprocal polynomials showing that they exist for every even degree. Thus every extension of a finite field of even degree can be obtained by adjoining a root of an irreducible self-reciprocal polynomial.

MINZNER, R.

M053 Dust Storms: Great Plains, Africa, and Mars

P. M. Woiceshyn, R. Krauss (University of Wisconsin, Madison), R. Minzner (Goddard Space Flight Center), and W. Shenk (Goddard Space Flight Center)

Proc Tenth AMS Conf Severe Local Storms,
Omaha, Neb., October 18-21, 1977, pp 495-496

For abstract, see Woiceshyn, P. M.

MITTRA, R.

M054 Synthesis of a Laterally Displaced Cluster Feed for a Reflector Antenna With Application to Multiple Beams and Contoured Patterns

V. Galindo-Israel, S. Lee, and R. Mittra

IEEE Trans Anten Prop, Vol AP-26, No 2, pp 220-228, March 1978

For abstract, see Galindo-Israel, V.

MIYAHIRA, T. F.

M055 Characterization of Solar Cells for Space Applications: Electrical Characteristics of Solarex 50-Micron Solar Cells as a Function of Intensity and Temperature

R. G. Downing, T. F. Miyahira, and R. S. Weiss

JPL Publication 78-15, Vol II, August 15, 1978

For abstract, see Downing, R. G.

MOACANIN, J.

M056 Synthesis and Biological Screening of Novel Hybrid Fluorocarbon Hydrocarbon Compounds for Use as Artificial Blood Substitutes—Annual Report, July 1976–July 1977

J. Moacanin, K. Scherer, A. Toronto (Utah Biological Test Laboratory), D. Lawson, T. Terranova, L. Astle (Utah Biological Test Laboratory), and S. Harvey (Utah Biological Test Laboratory)

JPL Publication 77-80, January 15, 1978

The goal of this project is to prepare a series of hybrid fluorochemicals of general structure $R_1^1 R_1^2 R_1^3 CR^4$, where the R_1^i 's are saturated fluoroalkyl groups of formula $C_n F_{2n+1}$, and R^4 is an alkyl group $C_n H_{2n+1}$ or related moiety containing amino, ether or ester functions but no C-F bonds. We proposed that compounds of this class containing eight to about twenty carbons total would have physical properties suitable for use as the oxygen-carrying phase of fluorochemical emulsion artificial blood, and that there was reason to hope for non-toxicity. Our program includes the chemical synthesis, physical testing and biological testing of pure single isomers of the proposed artificial blood candidate compounds.

Prepared for the Division of Blood Diseases and Resources, National Heart, Lung and Blood Institute, National Institutes of Health

MOHL, C. F.

M057 Proceedings of the Alternate Energy Systems Seminar

M. E. Alper, R. E. Bartera, H. S. Davis, R. G. Forney, C. F. Mohl, H. J. Stewart, and V. C. Truscello

JPL Publication 78-45, March 30, 1978

For abstract, see Alper, M. E.

MOLINDER, J. I.

M058 A Tutorial Introduction to Very Long Baseline Interferometry (VLBI) Using Bandwidth Synthesis

J. I. Molinder

The Deep Space Network Progress Report 42-46
May and June 1978, pp 16-28, August 15, 1978

This article gives a tutorial presentation of the basic principles underlying Very Long Baseline Interferometry (VLBI) using bandwidth synthesis. Although many subtle details are ignored, the article presents the basic signal processing approach and summarizes results showing the tradeoff of measurement accuracy with spanned bandwidth, source strength, antenna size and efficiency, system noise temperature, and data volume. Results pertaining to minimization of required antenna time for a given baseline measurement accuracy are also discussed.

MORABITO, L. A.

M059 Inflight Performance of the Viking Visual Imaging Subsystem

K. P. Klaasen, T. E. Thorpe, and L. A. Morabito

Appl Opt, Vol 16, pp 3158-3170,
December 1977

For abstract, see Klaasen, K. P.

MORETTI, V. C.

M060 Potential for Cogeneration of Heat and Electricity in California Industry—Phase I: Final Report

H. S. Davis, R. M. Gurfield, V. C. Moretti, and
M. L. Slonski

JPL Publication 78-42, May 1, 1978

For abstract, see Davis, H. S.

MORRIS, G. A., JR.

M061 JPL 2²⁰ Channel 300 MHz Bandwidth Digital Spectrum Analyzer

G. A. Morris, Jr. and H. C. Wilck

The Deep Space Network Progress Report 42-46
May and June 1978, pp. 57-61, August 15, 1978

A million (2²⁰) channel, 300 MHz bandwidth, digital spectrum analyzer is being constructed at the Jet Propulsion Laboratory. The design, fabrication, and maintenance philosophy of the modular, pipelined, Fast Fourier Transform (FFT) hardware are described. The spectrum analyzer will be used to examine the region from 1.4 GHz to 26 GHz for Radio Frequency Interference (RFI) which may be harmful to present and future tracking missions of the Deep Space Network. The design will have application to the Search for Extraterrestrial Intelligence (SETI) signals and radio science phenomena.

MORRIS, R.

M062 Voyager Support

R. Morris

The Deep Space Network Progress Report 42-44
January and February 1978, pp 16-33, April 15, 1978

This is a first in a series of Deep Space Network reports on Tracking and Data Acquisition support for Project Voyager. This report covers the Network's pre-launch preparations and flight support through 31 December 1977.

MOSHER, J. A.

M063 Lunar Spectral Units: A Northern Hemispheric Mosaic

T. V. Johnson, J. A. Mosher, and D. L. Matson

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 1013-1028

For abstract, see Johnson, T. V.

M064 A TiO₂ Abundance Map for the Northern Maria

T. V. Johnson, R. S. Saunders,
D. L. Matson, and J. A. Mosher

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 1029-1036

For abstract, see Johnson, T. V.

MUDGWAY, D. J.

M065 Tracking and Data System Support for the Viking 1975 Mission to Mars: Extended Mission Operations December 1976 to May 1978

D. J. Mudgway

Technical Memorandum 33-783, Vol IV,
December 15, 1978

This document describes and evaluates the support provided by the Deep Space Network to the Viking Extended Mission from December 1976 through May 1978.

Tracking and data acquisition support required the continuous operation of a worldwide network of tracking stations with 64-meter and 26-meter diameter antennas, together with a global communications system for the transfer of commands, telemetry, and radio metric data between the stations and the Network Operations Control Center in Pasadena, California.

Performance of the deep-space communications links between Earth and Mars and innovative new manage-

ment techniques for operations and data handling are included

MUELLER, W. A.

M066 Development and Evaluation of Elastomeric Materials for Geothermal Applications—Annual Report, October 1976–October 1977

W. A. Mueller, W. H. Kalfayan, W. W. Reilly, and J. D. Ingham

JPL Publication 78-69, September 1, 1978

The goal of this work is the development and evaluation of elastomeric materials for geothermal applications. A survey of organizations with experience in petroleum and geothermal drilling and logging operations was performed to obtain detailed information on service requirements for geothermal elastomers. On the basis of results of this survey, it was decided to attempt to develop a material for a casing packer for service at 260°C (~500°F) and 10.3 MPa (1500 psia) for 24 hours in a geothermal environment.

Work was divided into synthesis of new elastomers (block copolymers) and formulation of available materials. Formulation includes use of commercial elastomer gumstocks and also crosslinking of plastic (high T_g) materials and examination of their properties at high temperatures.

As a result of the work to date and discussions with other investigators in this field, the performance goals have been revised, and are now a tensile strength of 400 psi and 50% elongation at 260°C, with service life as before. Work carried out to date suggests that new synthetic polymers, such as those being investigated, will be required for service in geothermal environments at high temperatures. A possible alternative may be chemical modification of known polymer systems with second order transition temperatures, T_g, of about 100°C.

Prepared for the Department of Energy, DGE/1026-1, Distribution Category UC-66d

MULHALL, B. D. L.

M067 The DSN VLBI System, Mark I-79

B. D. L. Mulhall

The Deep Space Network Progress Report 42-46
May and June 1978, pp 5–15, August 15, 1978

The DSN VLBI System has been established as a new Network System. This article describes the system and discusses the system functional requirements.

M068 VLBI-Laser Intercomparison Project

B. D. L. Mulhall

The Deep Space Network Progress Report 42-46
May and June 1978, pp 87–91, August 15, 1978

The VLBI-Laser Intercomparison Project was established at the direction of NASA to assess state-of-the-art geodetic measurement systems being developed by NASA. A Project plan describing the objectives of the Project, the methods for making the assessment, and the schedule was reviewed. The plan was approved and published. This article describes the contents of the plan.

MURRAY, B. C.

M069 Extraterrestrial Intelligence: An Observational Approach

B. C. Murray, S. Gulkis, and R. E. Edelson

Science, Vol 199, pp 485–492, February 3, 1978

The microwave region of the electromagnetic spectrum, a plausible regime for signals from extraterrestrial intelligences, is largely unexplored. With new technology, particularly in data processing and low-noise reception, surveys can be conducted over broad regions of frequency and space with existing antennas at flux densities plausible for interstellar signals. An all-sky, broad-band survey lasting perhaps 5 years can be structured so that even negative results would establish significant boundaries on the regime in which such signals may be found. The technology and techniques developed and much of the data acquired would be applicable to radio astronomy and deep-space communications.

NEAD, M. W.

N001 A Parameter Estimation Subroutine Package

G. J. Bierman and M. W. Nead

JPL Publication 77-26, Rev. 2, October 15, 1978

For abstract, see Bierman, G. J.

NEFF, D.

N002 Low-Noise Receivers. S-Band Parametric Upconverter Development

S. Petty, D. Neff, and D. Norris

The Deep Space Network Progress Report 42-48
September and October 1978, pp 31–47,
December 15, 1978

For abstract, see Petty, S.

NELSON, D. L.

N003 The Isostatic State of the Lunar Apennines and Regional Surroundings

A. J. Ferrari, D. L. Nelson (California Institute of Technology), W. L. Sjogren, and R. J. Phillips

J Geophys Res, Vol 83, No B6, pp 2863-2871, June 10, 1978

For abstract, see Ferrari, A. J

NERHEIM, N. M.

N004 Effect of Dissociation Pulse Circuit Inductance on the CuCl Laser

A. A. Vetter (California Institute of Technology) and N. M. Nerheim

IEEE J Quantum Electron, Vol QE-14, No 2, pp 73-74, February 1978

For abstract, see Vetter, A. A.

N005 Scaling a Double-Pulsed Copper Chloride Laser to 10 mJ

N. M. Nerheim, A. A. Vetter (California Institute of Technology), and G. R. Russell

J Appl Phys, Vol 49, No 1, pp 12-15, January 1978

By use of low-inductance ($0.5 \mu\text{H}$) discharge circuits, pulses of 9.6 mJ were obtained from a double-pulsed CuCl laser. An oscillator-amplifier configuration produced a pulse energy of 11 mJ. Scaling studies indicate that additional increases in the laser energy could be obtained by increasing the discharge voltage above 20 kV and/or by increasing the laser-tube dimensions.

NERHIEM, N. M.

N006 A Continuously Pulsed Copper Halide Laser with a Cable-Capacitor Blumlein Discharge Circuit

N. M. Nerhiem, A. M. Bhanji, and G. R. Russell

IEEE J Quantum Electron, Vol QE-14, No 9, pp 686-693, September 1978

Experimental characteristics of a continuously pulsed copper halide laser with a cable-capacitor Blumlein discharge circuit are reported. Quartz laser tubes 1 m in length and 1.5 and 2.5 cm in diameter were employed to study the effects of the electrical circuit, laser tube, and buffer gas on laser performance. Measured properties of the Blumlein circuit are compared with an analytic solution for an idealized circuit. Both CuCl and CuBr with neon and helium buffer gas were studied. A maximum

average power of 12.5 W was obtained with a 1.5 nF capacitor charged to 8 kV and discharged at 31 kHz with CuCl and neon buffer gas at 0.7 kPa in a 2.5-cm-diam tube. A maximum efficiency of 0.72 percent was obtained at 9 W average power. Measurements of the radial distribution of the power in the laser beam and the variation of laser power at 510.6 and 578.2 nm with halide vapor density are also reported. Double and continuously pulsed laser characteristics are compared, and the role of copper metastable level atoms in limiting the laser pulse energy density is discussed.

NEUGEBAUER, M.

N007 The Energetic Particle Environment of the Solar Probe Mission—As Estimated by the Participants in the Solar Probe Environment Workshop

M. Neugebauer, L. A. Fisk, R. E. Gold, R. P. Lin, G. Newkirk, J. A. Simpson, and M. A. I. Van Hollebeke

JPL Publication 78-64, September 1, 1978

NASA's long range plan for the study of solar-terrestrial relations includes a Solar Probe Mission in which a spacecraft is placed in an eccentric orbit with perihelion at four solar radii. In the present concept of the mission, this orbit is attained by a Jupiter gravity-assist maneuver. A reasonable mission plan would require that there be no more than a 1% chance that the peak fluxes and fluences encountered near the Sun exceed those of the Jupiter flyby. It is shown that, if the assumptions in the calculations are correct, this requirement can be met. Some of the crucial assumptions underlying this conclusion are that, at four solar radii, there are no closed, stable configurations in which energetic particles are stored, and that energetic particles do not suffer appreciable energy loss in traveling from 4 solar radii to 1 AU. The spacecraft could suffer fatal radiation damage (1) if it encountered one of the extremely large solar flares which occur, on the average, about once every ten years, (2) if there are invisible regions of trapped radiation and the spacecraft happened to pass through one of them, or (3) if there is some mechanism which causes an adiabatic energy loss so that the near-solar particles are appreciably more energetic than those observed at 1 AU. All these catastrophes are considered to be unlikely. It is also concluded that, although it is highly improbable that solar neutrons would be hazardous to the health of the spacecraft, there is a severe problem in limiting the neutron flux from a radioactive power supply to a level which allows solar neutrons to be detected.

N008 Plasma Fluctuations in the Solar Wind

M. Neugebauer, C. S. Wu (University of Maryland, College Park), and J. D. Huba (Naval Research Laboratory, Washington, D. C.)

J Geophys Res, Vol 83, No. A3, pp. 1027-1034, March 1, 1978

Ogo 5 plasma and magnetic field data are used to compute power spectra of solar wind fluctuations over the frequency interval 10^{-3} - 10^{-1} Hz. We confirm the validity of the assumption made in earlier papers that the power spectra calculated from total flux measurements are approximately equal to the power spectra of density fluctuations times the square of the average solar wind speed. The relative density power spectrum is usually of the same order of magnitude as the power spectrum of speed fluctuations relative to the Alfvén speed. All cases studied show evidence of the presence of Alfvén waves in this frequency range. In some data sets the density and field fluctuations are consistent with magnetosonic waves. In other sets the ratio of the power in field magnitude fluctuations to that in density fluctuations is inconsistent with magnetosonic waves, for these cases we postulate static inhomogeneities with a balance between electron thermal and magnetic pressures. Finally, we suggest that the power enhancements near 1 Hz reported in earlier papers may be caused by a resonant proton cyclotron instability driven by the proton thermal anisotropy in the solar wind.

NEWBURN, R. L., JR.

N009 Postperihelion Interference Filter Photometry of the "Annual" Comet P/Encke

R. L. Newburn, Jr. and T. V. Johnson

Icarus, Vol 35, pp. 360-368, 1978

Interference filter photometry was taken of Comet Encke on June 14, 1974 (1.07 AU heliocentric distance, post-perihelion) at the CTIO (Cerro Tololo Interamerican Observatory) 150-cm reflector. Production rates were calculated of 4.1×10^{23} mol sec⁻¹ of CN, 5.3×10^{23} mol sec⁻¹ of C₃, and 4.3×10^{24} mol sec⁻¹ of C₂. These are about three times smaller than at comparable heliocentric distance perihelion, assuming a value of 100 for the ratio H₂O/(C₂ + C₃ + CN). An upper limit was placed on the production of nonvolatiles at about one-third that of volatiles in mass by assuming a bulk density of 1 g cm⁻³, a particle geometric albedo of 0.1, and a phase function of 0.2.

NEWHALL, X. X.

N010 Tests of General Relativity Using Astrometric and Radio Metric Observations of the Planets

J. D. Anderson, M. S. W. Keesey, E. L. Lau, E. M. Standish, Jr., and X. X. Newhall

Astronautica, Vol 5, pp. 43-61, 1978

For abstract, see Anderson, J. D.

NEWKIRK, G.

N011 The Energetic Particle Environment of the Solar Probe Mission—As Estimated by the Participants in the Solar Probe Environment Workshop

M. Neugebauer, L. A. Fisk, R. E. Gold, R. P. Lin, G. Newkirk, J. A. Simpson, and M. A. I. Van Hollebeke

JPL Publication 78-64, September 1, 1978

For abstract, see Neugebauer, M.

NG, A. T. Y.

N012 Experimental Determination of Mercury's Mass and Oblateness

P. B. Esposito, J. D. Anderson, and A. T. Y. Ng

COSPAR Space Research, Vol XVII, pp. 639-644, 1978

For abstract, see Esposito, P. B.

NIGHTINGALE, D.

N013 CCIR Paper on the Radiocommunications Requirements for Systems to Search for Extraterrestrial Life

D. Nightingale

The Deep Space Network Progress Report 42-45, March and April 1978, pp. 224-244, June 15, 1978

Three separate JPL papers and one Japanese paper were originally submitted to Study Group 2 of the International Radio Consultative Committee (CCIR) on the subject of the search for extraterrestrial intelligence. During the Final Meeting of Study Group 2 in Geneva in September-October 1977, a working party headed by Mr. Sam Brunstein of JPL combined these four papers into a single report. This article presents this report in its final CCIR format. The report considers propagation factors, preferred frequency bands, system characteristics and requirements, and interference.

NIPPER, E. J.

N014 Network Telemetry System Performance Tests in Support of the Mark III Data System Implementation

R. D. Rey and E. J. Nipper

The Deep Space Network Progress Report 42-45
March and April 1978, pp 294-301, June 15,
1978

For abstract, see Rey, R. D

NORMAN, A.

N015 Effect of Ultrasonic Irradiation of Mammalian Cells and Chromosomes *in vitro*

J. A. Roseboro, P. Buchanan (University of North Carolina, Chapel Hill), A. Norman (University of California, Los Angeles), and R. Stern (University of California, Los Angeles)

Phys Med. Biol, Vol. 23, No. 2, pp. 324-331,
1978

For abstract, see Roseboro, J. A.

NORRIS, D.

N016 Low-Noise Receivers: S-Band Parametric Upconverter Development

S. Petty, D. Neff, and D. Norris

The Deep Space Network Progress Report 42-48
September and October 1978, pp 31-47,
December 15, 1978

For abstract, see Petty, S

NOVOTNY, M.

N017 Optical, Spin-Resonance, and Magnetoresistance Studies of (Tetrathiatetracene)₂(Iodide)₃. The Nature of the Ground State

R. B. Somoano, S. P. S. Yen, V. Hadek,
S. K. Khanna, M. Novotny (Stanford University),
T. Datta (Tulane University),
A. M. Hermann (Tulane University), and
J. A. Woollam (Lewis Research Center)

Phys Rev., Pt B Solid State, Vol 17, No 7, pp
2853-2857, April 1, 1978

For abstract, see Somoano, R. B

O'DONNELL, T.

0001 Compatibility Studies of Various Refractory Materials in Contact with Molten Silicon

T. O'Donnell, M. Leopold, and M. Hagan

JPL Publication 78-18, March 1, 1978

The production of low cost, efficient solar cells for terrestrial electric power generation involves the manipulation of molten silicon with a present need for noncontaminating high-temperature refractories to be used as containment vessels, ribbon-production dies and dip-coated substrates. Studies were conducted on the wetting behavior and chemical/physical interactions between molten silicon and various refractory materials.

Prepared for the Department of Energy, DOE/JPL-1012-77/6, Distribution Category UC-63

O'NEIL, W. J.

0002 An Overview of Viking Navigation

W. J. O'Neil

Navigation J Inst Navig, Vol 25, No 1, pp. 1-10, Spring 1978

NASA soft-landed two Viking spacecraft on Mars in July and September 1976. The landings of these identical spacecraft more than 300 million km from earth were flawless. Viking-1 landed within 30 km of its target—Viking-2 within 10 km. The science experiments onboard the Vikings continued to operate long after the tremendously successful primary surface missions.

This paper describes the Viking flight path design and the actual inflight control of Viking-1's path from earth launch to Mars landing. Since the control of Viking-2 was similar and less stressful, it is not discussed.

OHLSON, J. E.

0003 Absolute Flux Density Calibrations: Receiver Saturation Effects

A. J. Freiley, J. E. Ohlson, and B. L. Seidel

The Deep Space Network Progress Report 42-46
May and June 1978, pp 123-129, August 15,
1978

For abstract, see Freiley, A. J

OHTAKAY, H.

0004 Attitude Determination System for a Nadir-Pointing Satellite

W. F. Havens and H. Ohtakay

J Guidance Contr, Vol 1, No 5, pp 352-358,
September-October 1978

For abstract, see Havens, W. F

OLLI, E. E.

0005 Fourth-Order Acoustic Torque in Intense Sound Fields

T. G. Wang, H. Kanber, and E. E. Olli

J Acoust Soc Amer, Vol 63, No 5, pp 1332-1334, May 1978

For abstract, see Wang, T G

OLSASKY, M. J.

0006 Wide Area Detection System: Conceptual Design Study

E. E. Hilbert, C. Carl, W. Goss, G. R. Hansen, M. J. Olsasky, and A. R. Johnston

JPL Publication 78-32, February 1978

For abstract, see Hilbert, E. E

OLSEN, E. T.

0007 Evidence for the Depletion of Ammonia in the Uranus Atmosphere

S. Gulkis, M. A. Janssen, and E. T. Olsen

Icarus, Vol 34, No 1, pp 10-19, April 1978

For abstract, see Gulkis, S

ONDRASIK, V. J.

0008 A Demonstration of Differenced Dual-Station One-Way Doppler Conducted with Pioneer 11

C. C. Chao, V. J. Ondrasik, and H. L. Siegel

The Deep Space Network Progress Report 42-45 March and April 1978, pp 104-110, June 15, 1978

For abstract, see Chao, C C

OTOSHI, T. Y.

0009 A Method for Measuring Group Time Delay Through a Feed Horn

T. Y. Otoshi, R. B. Lyon, and M. Franco

The Deep Space Network Progress Report 42-44 January and February 1978, pp 82-89, April 15, 1978

A technique is described for measurement of time delay through a feed horn. The technique consists of measuring the time delay between the input and output ports of two identical horns separated by a known airpath dis-

tance. Ground multipath signals, which normally produce errors in this type of measurement, were identified and eliminated by using a time domain technique. Experimental results at 2113 MHz showed good agreement with calculated values.

0010 Analysis of Hydrogen Maser Frequency Drift Due to Possible Drifts in Load VSWR and Phase Angle of Reflection Coefficient

R. W. Beatty and T. Y. Otoshi

The Deep Space Network Progress Report 42-45 March and April 1978, pp 245-252, June 15, 1978

For abstract, see Beatty, R. W

0011 DSN Portable Zero Delay Assembly

E. J. Serhal, Jr. and T. Y. Otoshi

The Deep Space Network Progress Report 42-46 May and June 1978, pp 130-138, August 15, 1978

For abstract, see Serhal, E J, Jr

0012 Updated Z-Corrections for 64-m DSS Ground Station Delay Calibrations

T. Y. Otoshi and K. R. Weld

The Deep Space Network Progress Report 42-47 July and August 1978, pp 77-84, October 15, 1978

This article presents new Z-corrections which resulted from recent translator path delay calibrations made at DSS 14, 43, and 63 with newly developed DSN Portable Zero Delay Assemblies.

OWEN, T.

0013 Mars: Regolith Adsorption and the Relative Concentrations of Atmospheric Rare Gases

F. P. Fanale, W. A. Cannon, and T. Owen (State University of New York, Stony Brook)

Geophys Res Lett, Vol 5, No 1, pp 77-80, January 1978

For abstract, see Fanale, F P

OXBORROW, G. S.

0014 Thermal Resistance of Naturally Occurring Airborne Bacterial Spores

J R Puleo, S L Bergstrom, J. T Peeler (Food and Drug Administration, Cincinnati, Ohio), and G S Oxborrow, (Food and Drug Administration, Minneapolis, Minnesota)

Appl Environ Microbiol, Vol 36, No 3, pp 473-479, September 1978

For abstract, see Puleo, J R

PANG, K.

P001 Multicolor Observations of Phobos With the Viking Lander Cameras Evidence for a Carbonaceous Chondritic Composition

J. B. Pollack (Ames Research Center), J. Veverka (Cornell University), K Pang (Planetary Science Institute), D. Colburn (Ames Research Center), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp 66-69, January 6, 1978

For abstract, see Pollack, J B

PANG, K. D.

P002 The Composition of Phobos: Evidence for Carbonaceous Chondrite Surface From Spectral Analysis

K. D. Pang (Planetary Science Institute), J. B. Pollack (Ames Research Center), J. Veverka (Cornell University), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp 64-66, January 6, 1978

A reflectance spectrum of Phobos (from 200 to 1100 nanometers) has been compiled from the Mariner 9 ultraviolet spectrometer, Viking lander imaging, and ground-based photometric data. The reflectance of the martian satellite is approximately constant at 5 percent from 1100 to 400 nanometers but drops sharply below 499 nanometers, reaching a value of 1 percent at 200 nanometers. The spectral albedo of Phobos bears a striking resemblance to that of asteroids (1) Ceres and (2) Pallas. Comparison of the reflectance spectra of asteroids with those of meteorites has shown that the spectral signature of Ceres is indicative of a carbonaceous chondritic composition. A physical explanation of how the compositional information is imposed on the reflectance spectrum is given. On the basis of a good match between the reflectance spectra of Phobos and Ceres and the extensive research that has been done to infer the composition of Ceres, it seems reasonable to believe that the surface composition of Phobos is similar to that of carbonaceous chondrites. This suggestion is consistent with the recently determined low density of Mar's inner satellite. Our

result and recent Viking noble gas measurements suggest different modes of origin for Mars and Phobos

PARKER, R E.

P003 Thorium Concentrations in the Lunar Surface. I: Regional Values and Crustal Content

A. E Metzger, E L Haines, R. E. Parker, and R. G. Radocinski

Proc Eighth Lunar Sci Conf Houston, Tex, March 14-18, 1977, pp 949-999

For abstract, see Metzger, A E

PARTHASARATHY, S. P.

P004 Influence of Internally Generated Pure Tones on the Broadband Noise Radiated from a Jet

S P. Parthasarathy, R. Cuffel, and P F Massier
AIAA J, Vol 16, No 5, pp 538-540, May 1978

The amplification of jet noise by plane waves of sound generated upstream of the nozzle is investigated. It is shown that a significant increase of broadband noise occurs only when the amplitude of the tone in the far field exceeds the sound pressure of the broadband noise at the same location in the far field, and that the sensitivity of the jet to pure tone excitation is otherwise comparatively small.

PEASE, G. E.

P005 Estimates of Precession and Polar Motion Errors from Planetary Encounter Station Location Solutions
G E. Pease

The Deep Space Network Progress Report 42-43
November and December 1977, pp 29-49,
February 15, 1978

Jet Propulsion Laboratory Deep Space Station (DSS) location solutions based on two JPL planetary ephemerides, DE 84 and DE 96, at eight planetary encounters have been used to obtain weighted least squares estimates of precession and polar motion errors. The solution for precession error in right ascension yields a value of $0.3 \times 10^{-5} \pm 0.8 \times 10^{-6}$ deg/year. This maps to a right ascension error of $1.3 \times 10^{-5} \pm 0.4 \times 10^{-5}$ deg at the first Voyager 1979 Jupiter encounter if the current JPL DSS location set is used. Solutions for precession and polar motion using station locations based on DE 84 agree well with the solution using station locations referenced to DE 96. The precession solution removes the apparent drift in station longitude and spin axis distance estimates, while the encounter polar motion solutions

consistently decrease the scatter in station spin axis distance estimates

PECKHAM, G. E.

P006 A Microwave Pressure Sounder

D. A. Flower and G. E. Peckham (Heriot-Watt University, Edinburgh, Scotland)

JPL Publication 78-68, August 1, 1978

For abstract, see Flower, D. A.

PEELER, J. T.

P007 Thermal Resistance of Naturally Occurring Airborne Bacterial Spores

J. R. Puleo, S. L. Bergstrom, J. T. Peeler (Food and Drug Administration, Cincinnati, Ohio), and G. S. Oxborrow, (Food and Drug Administration, Minneapolis, Minnesota)

Appl Environ Microbiol, Vol 36, No 3, pp 473-479, September 1978

For abstract, see Puleo, J. R.

PENG, T. K. C.

P008 Fully Automated Urban Traffic System

B. M. Dobrotin, T. K. C. Peng, G. R. Hansen, and D. A. Rennels

JPL Publication 77-64, December 1977

For abstract, see Dobrotin, B. M.

P009 Automated Mixed Traffic Vehicle (AMTV) Technology and Safety Study

A. R. Johnston, T. K. C. Peng, H. C. Vivian, and P. K. Wang

JPL Publication 78-12, February 1978

For abstract, see Johnston, A. R.

PENZO, P. A.

P010 Voyager Mission Description

C. E. Kohlhasse and P. A. Penzo

Space Sci Rev, Vol 21, No 2, pp 77-101, November 1977

For abstract, see Kohlhasse, C. E.

PETERSON, R. E.

P011 An Investigation of the Side Force that is Sometimes Observed in Rocket Start-Up

J. M. Bowyer, Jr., G. W. Kreiter (Vought Corporation), and R. E. Peterson (University of Arizona)

Preprint 78-1045, AIAA/SAE Fourteenth Joint Propulsion Conf., Las Vegas, Nevada, July 25-27, 1978

For abstract, see Bowyer, J. M., Jr.

PETTY, S.

P012 Low-Noise Receivers: S-Band Parametric Upconverter Development

S. Petty, D. Neff, and D. Norris

The Deep Space Network Progress Report 42-48 September and October 1978, pp 31-47, December 15, 1978

The combination of a cryogenically-cooled parametric upconverter and a higher frequency maser post amplifier has been proposed as a method of achieving maser-like receiver noise temperatures over much larger instantaneous bandwidths and tuning ranges than are presently obtainable with masers in the range of 1 to 18 GHz. An experimental 2.0- to 2.5-GHz parametric upconverter/maser system has been developed to explore these possibilities. Initial tests of this system have resulted in an effective input noise temperature of 3.1 K at 2295 MHz and 3.2 K at 2388 MHz. The parametric upconverter has logged over 1500 hours at 4.5 K and has undergone 5 thermal cycles (300 K to 4.5 K to 300 K) without degradation.

PHILLIPS, H.

P013 DSS 13 Antenna Subsystem Automation

H. Phillips, I. Crane, and P. Lipsius

The Deep Space Network Progress Report 42-46 May and June 1978, pp 73-75, August 15, 1978

Unattended station operation has been implemented at DSS 13, permitting full operational control from NOCC. Sensors have been installed in the mechanical subsystem to monitor critical functions. These are arranged to permit automated premission checkout of the subsystem, automated reaction to component failure, and identification of failed components under control of the antenna pointing computer. This monitoring installation will serve as a prototype for monitoring equipment to be installed throughout the DSN.

PHILLIPS, R. J.

P014 The Isostatic State of the Lunar Apennines and Regional Surroundings

A. J. Ferrari, D. L. Nelson (California Institute of Technology), W. L. Sjogren, and R. J. Phillips

J Geophys Res, Vol 83, No B6, pp 2863-2871, June 10, 1978

For abstract, see Ferrari, A J

P015 Equipotential Doming in Flooded Circular Basins on the Moon

L. E. Roth, C. Elachi, and R. J. Phillips

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 643-654

For abstract, see Roth, L E

PHILLIPS, W. M.

P016 Sialons as High Temperature Insulators

W. M. Phillips and Y. S. Kuo

JPL Publication 78-103, December 1, 1978

Sialons have been evaluated for application as high temperature electrical insulators in contact with molybdenum and tungsten components in hard vacuum applications. Both DC and variable frequency AC resistivity data indicate the sialons to have electrical resistivity similar to common oxide in the 1000°C or higher range. Metallographic evaluations indicate good bonding of the type 15R AlN polytype to molybdenum and tungsten. The β' or modified silicon nitride phase was unacceptable in terms of vacuum stability. Additives such as MgO which are commonly used to improve densification had a detrimental effect on electrical resistivity. Similar resistivity decreases were produced by additions of molybdenum or tungsten to form cermet. The use of hot pressing at 1800°C with AlN, Al₂O₃ and Si₃N₄ starting powders produced a better product than did a combination of SiO₂ and AlN starting powders. This study indicated that sialons will be suitable insulators in the 1600K range in contact with molybdenum or tungsten if they are produced as a pure ceramic and subsequently bonded to the metal components at temperatures in the 1600K range.

PIVIROTTI, D. S.

P017 Process Heat in California Applications and Potential for Solar Energy in the Industrial, Agricultural and Commercial Sectors

R. H. Barbieri, R. E. Bartera, E. S. Davis, G. E. Hlavka, D. S. Pivrotto, and G. Yanow

JPL Publication 78-33, March 1978

For abstract, see Barbieri, R. H

POLLACK, J. B.

P018 The Composition of Phobos: Evidence for Carbonaceous Chondrite Surface From Spectral Analysis

K. D. Pang (Planetary Science Institute), J. B. Pollack (Ames Research Center), J. Veverka (Cornell University), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp 64-66, January 6, 1978

For abstract, see Pang, K. D

P019 Multicolor Observations of Phobos With the Viking Lander Cameras: Evidence for a Carbonaceous Chondritic Composition

J. B. Pollack (Ames Research Center), J. Veverka (Cornell University), K. Pang (Planetary Science Institute), D. Colburn (Ames Research Center), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp 66-69, January 6, 1978

The reflectivity of Phobos has been determined in the spectral region from 0.4 to 1.1 micrometers from images taken with a Viking lander camera. The reflectivity curve is flat in this spectral interval and the geometric albedo equals 0.05 ± 0.01 . These results, together with Phobos's reflectivity spectrum in the ultraviolet, are compared with laboratory spectra of carbonaceous chondrites and basalts. The spectra of carbonaceous chondrites are consistent with the observations, whereas the basalt spectra are not. These findings raise the possibility that Phobos may be a captured object rather than a natural satellite of Mars.

POLLOCK, G. A.

P020 Effect of Multiblade Slurry Saw Induced Damage on Silicon Solar Cells

T. Daud, J. K. Liu, G. A. Pollock, and K. M. Koliwad

Conf Rec Thirteenth IEEE Photovoltaic Spec Conf, Washington, DC, June 5-8, 1978, pp 142-146

For abstract, see Daud, T

POMPHREY, R. B.

P021 IPL Processing of the Viking Orbiter Images of Mars

R. M. Ruiz, D. A. Elliott, G. M. Yagi,
R. B. Pomphrey, M. A. Power, K. W. Farrell, Jr.,
J. J. Lorre, W. D. Benton, R. E. Dewar, and
L. E. Cullen

J Geophys Res, Vol 82, No 28, pp 4189-4202,
September 30, 1977

For abstract, see Ruiz, R. M

POSNER, E. C.

P022 Life Cycle Costing With a Discount Rate

E. C. Posner

Utilitas Math, Vol 13, pp 157-188, 1978

This article studies life cycle costing for a capability needed for the indefinite future, and specifically the dependence of optimal policies on the discount rate chosen. The two costs considered are reprourement cost and maintenance and operations (M&O) cost. The reprourement price is assumed known, and the M&O costs are assumed to be a known function of the time since last reprourement, in fact, a nondecreasing function. The problem is to choose the optimum reprourement time so as to minimize the quotient of the total cost over a reprourement period divided by the period. Or one could assume a discount rate and try to minimize the total discounted costs into the indefinite future. It is shown that the optimum policy in the presence of a small discount rate hardly depends on the discount rate at all, and leads to essentially the same policy as in the case in which discounting is not considered. It is also shown that the minimum cost normalized by multiplying by the discount rate α is a decreasing function of α unless the M&O costs are constant as a function of time.

POTTER, P. D.

P023 Hydrogen Maser Frequency Standard Computer Model for Automatic Cavity Tuning Servo Simulations

P. D. Potter and C. Finnie

The Deep Space Network Progress Report 42-47
July and August 1978, pp 29-38, October 15,
1978

A computer model of the JPL hydrogen maser frequency standard has been developed. This model allows frequency stability data to be generated, as a function of various maser parameters, many orders of magnitude faster than these data can be obtained by experimental

test. In particular, the maser performance as a function of the various automatic tuning servo parameters may be readily determined.

POUNDER, E.

P024 Seasat-A Opens New Phase in Earth Observations

E. Cutting and E. Pounder

Astronaut Aeronaut, Vol 16, No 6, pp 42-50,
June 1978

For abstract, see Cutting, E

POWELL, R. V.

P025 An Entree for Large Space Antennas

R. V. Powell and A. R. Hibbs

Astronaut Aeronaut, Vol 15, No 12, pp 58-64,
December 1977

A 30-meter mesh deployable antenna system is discussed as the logical first step in developing large space antennas and in pressing their timely applications.

POWER, M. A.

P026 IPL Processing of the Viking Orbiter Images of Mars

R. M. Ruiz, D. A. Elliott, G. M. Yagi,
R. B. Pomphrey, M. A. Power, K. W. Farrell, Jr.,
J. J. Lorre, W. D. Benton, R. E. Dewar, and
L. E. Cullen

J Geophys Res, Vol 82, No 28, pp 4189-4202,
September 30, 1977

For abstract, see Ruiz, R. M

PRESTON, R. A.

P027 Δ VLBI Spacecraft Tracking System Demonstration: Part I. Design and Planning

D. L. Brunn, R. A. Preston, S. C. Wu,
H. L. Siegel, D. S. Brown, C. S. Christensen, and
D. E. Hilt

The Deep Space Network Progress Report 42-45
March and April 1978, pp 111-132, June 15,
1978

For abstract, see Brunn, D. L.

P028 Establishing a Celestial VLBI Reference Frame—I. Searching for VLBI Sources

R. A. Preston, et al.

The Deep Space Network Progress Report 42-46
May and June 1978, pp 46-56, August 15, 1978

The Deep Space Network is currently engaged in establishing a new high-accuracy VLBI celestial reference frame. This article discusses the present status of the task of finding suitable celestial radio sources for constructing this reference frame. To date, 564 VLBI sources have been detected, with 166 of these lying within 10° of the ecliptic plane. The variation of the sky distribution of these sources with source strength is examined.

Contributors to this article include

Jet Propulsion Laboratory R. A. Preston, D. D. Morabito, J. G. Williams, M. A. Slade, A. W. Harris, S. G. Finley, L. J. Skjerve, L. Tanida, and D. J. Spitzmesser

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Tidbinbilla Deep Space Communications Complex A. Bailey, R. Denise, J. Dickenson, R. Livermore, A. Papij, A. Robinson, and C. Taylor

Madrid Deep Space Communications Complex F. Alcazar, B. Luaces, and D. Munoz

PRICE, H.

P029 Planetary Benchmarks

C. Uphoff, R. Staehle, M. Kobrick, R. Jurgens, H. Price, M. Slade, and D. Sonnabend

JPL Publication 78-94, December 1, 1978

For abstract, see Uphoff, C.

PRICE, T. W.

P030 Evaluation of FIDC System: Final Report

R. A. Hall, M. W. Dowdy, and T. W. Price

JPL Publication 78-93, October 15, 1978

For abstract, see Hall, R. A.

PRICE, W. E.

P031 Voyager Electronic Parts Radiation Program: Test Requirements and Procedures

A. G. Stanley, K. E. Martin, and W. E. Price

JPL Publication 77-41, Vol II, December 15, 1978

For abstract, see Stanley, A. G.

PULEO, J. R.

P032 Thermal Resistance of Naturally Occurring Airborne Bacterial Spores

J. R. Puleo, S. L. Bergstrom, J. T. Peeler (Food and Drug Administration, Cincinnati, Ohio), and G. S. Oxborrow, (Food and Drug Administration, Minneapolis, Minnesota)

Appl Environ Microbiol, Vol 36, No 3, pp 473-479, September 1978

Simulation of a heat process used in the terminal dry-heat decontamination of the Viking spacecraft is reported. Naturally occurring airborne bacterial spores were collected on Teflon ribbons in selected spacecraft assembly areas and subsequently subjected to dry heat. Thermal inactivation experiments were conducted at 105, 111.7, 120, 125, 130, and 135°C with a moisture level of 1.2 mg of water per liter. Heat survivors were recovered at temperatures of 135°C when a 30-h heating cycle was employed. Survivors were recovered from all cycles studied and randomly selected for classification. The naturally occurring spore population was reduced an average of 2.2 to 4.4 log cycles from 105 to 135°C. Heating cycles of 5 and 15 h at temperature were compared with the standard 30-h cycle at 111.7, 120, and 125°C. No significant differences in inactivation ($\alpha = 0.05$) were observed between 111.7 and 120°C. The 30-h cycle differs from the 5- and 15-h cycles at 125°C. Thus, the heating cycle can be reduced if a small fraction (about 10^{-3} to 10^{-4}) of very resistant spores can be tolerated.

PUROHIT, G. P.

P033 Utilization of Waste Heat in Trucks for Increased Fuel Economy

C. J. Leising, G. P. Purohit, S. P. DeGrey, and J. G. Finegold

JPL Publication 78-39, May 1, 1978

For abstract, see Leising, C. J.

P034 Waste Heat Recovery in Truck Engines

C. J. Leising, G. P. Purohit, S. P. DeGrey, and J. G. Finegold

Preprint 780686, SAE West Coast Meet, San Diego, Calif, August 7-10, 1978

For abstract, see Leising, C. J.

RADOCINSKI, R. G.

R001 Thorium Concentrations in the Lunar Surface. I: Regional Values and Crustal Content

A. E. Metzger, E. L. Haines, R. E. Parker, and
R. G. Radocinski

*Proc Eighth Lunar Sci Conf Houston, Tex., March
14-18, 1977, pp 949-999*

For abstract, see Metzger, A. E.

RAIBERT, M. H.

R002 A Model for Sensorimotor Control and Learning

M. H. Raibert

Biol Cybernetics, Vol 29, pp 29-36, 1978

A model for motor learning, generalization, and adaptation is presented. It is shown that the equations of motion of a limb can be expressed in a parametric form that facilitates transformation of desired trajectories into plans. These parametric equations are used in conjunction with a quantized multidimensional memory organized by state variables. The memory is supplied with data derived from the analysis of *practice* movements. A small computer and mechanical arm are used to implement the model and study its properties. Results verify the ability to acquire new movements, adapt to mechanical loads, and generalize between similar movements.

RAUCH, L. L.

R003 On Estimating the Phase of a Periodic Waveform in Additive Gaussian Noise—Part I

L. L. Rauch

*The Deep Space Network Progress Report 42-45
March and April 1978, pp 152-164, June 15,
1978*

Motivated by recent advances in technology, a new look is taken at the problem of estimating the phase of a periodic waveform in additive gaussian noise. The maximum a posteriori probability criterion with signal space interpretation is used to obtain the structures of optimum and some suboptimum phase estimators for the following cases: (1) known constant frequency and unknown constant phase with an a priori distribution, (2) unknown constant frequency and phase with a joint a priori distribution, (3) frequency a parameterized function of time with a joint a priori distribution on parameters and phase, (4) frequency a gaussian random process. (Part I introduces the general problem and treats case 1)

REED, I. S.

R004 A Fast DFT Algorithm Using Complex Integer Transforms

I. S. Reed and T. K. Truong

*The Deep Space Network Progress Report 42-43
November and December 1977, pp 134-140,
February 15, 1978*

In this article Winograd's algorithm for computing the discrete Fourier transform (DFT) is extended considerably for certain large transform lengths. This is accomplished by performing the cyclic convolution, required by Winograd's method, by a fast transform over certain complex integer fields developed previously by the authors. This new algorithm requires fewer multiplications than either the standard fast Fourier transform (FFT) or Winograd's more conventional algorithm.

R005 Transform Decoding of Reed-Solomon Codes Over $GF(2^{2^n})$ Using the Techniques of Winograd

I. S. Reed (University of Southern California),
T. K. Truong, and B. Benjauthrit

*The Deep Space Network Progress Report 42-43
November and December 1977, pp 141-163,
February 15, 1978*

A new algorithm for computing a Fourier-like transform over $GF(2^{2^n})$, where $n = 1, 2, 3, 4, 5$, is developed to encode and decode Reed-Solomon (RS) codes of length 2^{2^n} . Such an RS decoder is considerably faster than a decoder that uses the conventional fast transform over $GF(2^{2^n})$.

R006 On Decoding of Reed-Solomon Codes Over $GF(32)$ and $GF(64)$ Using the Transform Techniques of Winograd

I. S. Reed (University of Southern California),
T. K. Truong, and B. Benjauthrit

*The Deep Space Network Progress Report 42-44
January and February 1978, pp 139-171,
April 15, 1978*

A new algorithm for computing a transform over $GF(2^n)$, where $n = 5, 6$, is developed to encode and decode Reed-Solomon (RS) codes of length $2^n - 1$. Such an RS decoder is considerably faster than the conventional transform decoder over $GF(2^n)$.

R007 A New Hybrid Algorithm for Computing a Fast Discrete Fourier Transform

I. S. Reed (University of Southern California) and
T. K. Truong

*The Deep Space Network Progress Report 42-45
March and April 1978, pp 172-185, June 15,
1978*

For certain long transform lengths, Winograd's algorithm for computing the discrete Fourier transform (DFT) is extended considerably. This is accomplished by performing the cyclic convolution, required by Wino-

grad's method, with the Mersenne-prime number-theoretic transform developed originally by Rader. This new algorithm requires fewer multiplications than either the standard fast Fourier transform (FFT) or Winograd's more conventional algorithm.

R008 A New Algorithm for Computing Primitive Elements in $GF(q^2)$

I. S. Reed (University of Southern California),
T. K. Truong, and R. L. Miller

The Deep Space Network Progress Report 42-45
March and April 1978, pp 190-196, June 15,
1978

A new method is developed to find primitive elements in the Galois field of q^2 elements $GF(q^2)$, where q is a Mersenne prime. Such primitive elements are needed to implement transforms over $GF(q^2)$.

R009 A Fast Computation of Complex Convolution Using a Hybrid Transform

I. S. Reed (University of Southern California) and
T. K. Truong

The Deep Space Network Progress Report 42-46
May and June 1978, pp 92-99, August 15, 1978

In this article, it is shown that the cyclic convolution of complex values can be performed by a hybrid transform. This transform is a combination of a Winograd transform and a fast complex integer transform developed previously by the authors. This new hybrid algorithm requires fewer multiplications than any previously known algorithm.

R010 A Simplified Algorithm for Correcting Both Errors and Erasures of R-S Codes

I. S. Reed (University of Southern California) and
T. K. Truong

The Deep Space Network Progress Report 42-48
September and October 1978, pp 66-71,
December 15, 1978

Using the finite field transform and continued fractions, a simplified algorithm for decoding Reed-Solomon codes is developed to correct erasures caused by other codes as well as errors over the finite field $GF(q^m)$, where q is a prime and m is an integer. Such an R-S decoder can be faster and simpler than a decoder that uses more conventional methods.

R011 On the Fundamental Structure of Galois Switching Functions

B. Benjauthrit and I. S. Reed

IEEE Trans Computers, Vol C-27, No 8,
pp 757-762, August 1978

For abstract, see Benjauthrit, B

REID, M. S.

R012 A Probabilistic Model of Insolation for the Mojave Desert Area

O. V. Hester and M. S. Reid

JPL Publication 78-11, March 1, 1978

For abstract, see Hester, O. V.

R013 The Engineering Analysis of Solar Radiation

M. S. Reid, C. L. Hamilton, and O. V. Hester

Policy Anal Inform Syst, Knowledge Systems
Laboratory, University of Illinois at Chicago,
pp 187-217, 1978

A necessary precursor to construction of well-designed, efficient, and economically viable solar energy systems is the engineering analysis not only of the systems themselves but also of the solar radiation that will drive them. This paper presents the first steps in such an analysis to support the design of solar thermal power systems. A rationale for development of an integrated approach to this analysis is outlined, and elements of the approach are described. A dynamic computer simulation of a conceptual system was employed in an initial sensitivity analysis to explore how performance estimates might be affected by the precision and amount of detail in solar radiation data used as model input. A measurement program, including instrumentation, used to characterize precisely and in detail the solar resource at one location is described, as is a probabilistic model derived from it, for predicting insolation as a function of time.

R014 Calibration Standards and Field Instruments for the Precision Measurement of Insolation

M. S. Reid, C. M. Berdahl, and
J. M. Kendall, Sr.

Solar Energy, Vol 20, pp 357-358, 1978

The possibility of using solar-powered energy systems on a relatively large scale is now being seriously considered, as there is continuing uncertainty over the supply and the price of conventional energy. A necessary precursor to construction of well-designed, efficient and economically viable solar energy systems is the engineering analysis not only of the systems themselves and the load requirements they are expected to meet, but also of the solar radiation that will drive them. The urgent need for a better solar radiation data base has been pointed out by Durrenberger and Brazel but is not yet widely recog-

nized They also state that there is a need for a Federally funded program for the development of reliable solar sensors that will provide accurate measurements of solar radiation.

This article describes National Aeronautics and Space Administration supported development of a radiation calibration standard and the design of a fieldworthy survey instrument based on the standard It also describes the survey instrument's performance for 2 yr in the field, together with a calibration stability analysis over this period, and the data bank of precision measured solar radiation accumulated by the use of these instruments

REILLY, W. W.

R015 Development and Evaluation of Elastomeric Materials for Geothermal Applications—Annual Report, October 1976–October 1977

W. A. Mueller, W. H. Kalfayan, W. W. Reilly, and J. D. Ingham

JPL Publication 78-69, September 1, 1978

For abstract, see Mueller, W. A.

REIMBAUM, A.

R016 Labeled Cells

A. Rembaum, S. P. S. Yen, and W. Volksen (IBM)

CHEMTECH, Vol 8, pp 182–190, March 1978

Specific biological cells can now be tagged with microsphere-bound antibodies so that they may be followed through the body This discovery and its possible applications to the understanding of biochemical mechanisms are discussed

Note *CHEMTECH* is also known as *Chemical Technology*

R017 Photoacoustic Spectroscopy of Organometallic Compounds With Applications in the Fields of Quasi-One-Dimensional Conductors and Catalysis

R. B. Somoano, A. Gupta, W. Volksen, A. Rembaum, and R. Williams (California Institute of Technology)

Organometallic Polymers, pp 165–174, Academic Press, Inc, New York, N Y, 1978

For abstract, see Somoano, R. B

R018 Electrical Properties of (DEPE) (TCNQ)₄

R. B. Somoano, V. Hadek, S. P. S. Yen, A. Rembaum, C. H. Hsu (California Institute of Technology), R. J. Deck (Tulane University), T. Datta (Tulane University), and A. M. Hermann (Tulane University)

Phys Stat Sol (B), Vol 81, No 1, pp 281–286, 1977

For abstract, see Somoano, R. B

REMER, D. S.

R019 The Role of Interest and Inflation Rates in Life-Cycle Cost Analysis

I. Eisenberger, D. S. Remer, and G. Lorden (California Institute of Technology)

The Deep Space Network Progress Report 42-43 November and December 1977, pp 105–109, February 15, 1978

For abstract, see Eisenberger, I

R020 Economic Evaluation of DSS 13 Unattended Operations Demonstration

D. S. Remer (Harvey Mudd College), I. Eisenberger, and G. Lorden (California Institute of Technology)

The Deep Space Network Progress Report 42-45 March and April 1978, pp 165–171, June 15, 1978

This article presents the goals and data collection requirements to be used for the economic and performance evaluation indices and life-cycle cost parameters for the upcoming operations demonstration of an automated Deep Space Station run unattended and controlled remotely from JPL These evaluation indices will compare the remote operation of telemetry at DSS 13 with the cost and performance of a comparable manned operation at DSS 11 A description is presented of the data that needs to be collected, how the data will be analyzed, and what can and cannot be learned from this operations demonstration.

R021 A Life Cycle Cost Economics Model for Automation Projects With Uniformly Varying Operating Costs

D. S. Remer

IEEE 1977 National Telecommunications Conference, Vol II, pp 32 4-1–32 4-6, IEEE, New York, N Y, 1977

A mathematical model is developed for calculating the life cycle costs for a project where the operating costs increase or decrease in a linear manner with time The life cycle cost is shown to be a function of the (1)

investment costs, (2) initial operating costs, (3) operating cost gradient, (4) project life time, (5) interest rate for capital, and (6) salvage value. The results show that the life cycle cost for a project can be grossly underestimated (or overestimated) if the operating costs increase (or decrease) uniformly over time rather than being constant as is often assumed in project economic evaluations. The following range of variables is examined: (1) project life from 2 to 30 years, (2) interest rate from 0 to 15% per year, and (3) operating cost gradient from 5-90% of the initial operating cost. A numerical example plus graphs is given to help the reader calculate project life cycle costs over a wide range of variables.

RENNELS, D. A.

R022 Fully Automated Urban Traffic System

B. M. Dobrotin, T. K. C. Peng,
G. R. Hansen, and D. A. Rennels

JPL Publication 77-64, December 1977

For abstract, see Dobrotin, B. M.

R023 Fault-Tolerant Building-Block Computer Study

D. A. Rennels

JPL Publication 78-67, July 15, 1978

The development of ultra-reliable core computers is a starting point for improving the reliability of complex military systems. Such computers can provide reliable fault diagnosis, failure circumvention, and, in some cases, serve as an automated repairman for their host systems.

This report describes a small set of building-block circuits which can be implemented as single VLSI devices, and which can be used with off-the-shelf microprocessors and memories to build Self Checking Computer Modules (SCCM). Each SCCM is a microcomputer which is capable of detecting its own faults during normal operation and is designed to communicate with other identical modules over one or more Mil Standard 1553A buses. Several SCCMs can be connected into a network with backup spares to provide fault-tolerant operation, i.e., automated recovery from faults. Alternative fault-tolerant SCCM configurations are discussed along with the cost and reliability associated with their implementation.

Prepared for the Naval Ocean Systems Center

R024 Reconfigurable Modular Computer Networks for Spacecraft On-Board Processing

D. A. Rennels

Computer, Vol. 11, No. 7, pp. 49-59, July 1978

This article addresses the issue of architectural reconfiguration as a means of achieving fault-tolerant computa-

tion. It describes a reconfigurable modular computer system for spacecraft use. Reliability is the severest constraint on the architecture of a spacecraft computing system; this paper shows how architectural reconfiguration enables the system to replace faulty modules with spares, increasing the reliability of the system.

R025 A Distributed Microprocessor System for Spacecraft Control and Data Handling

D. A. Rennels

Preprint, Minicomputer and Microcomputer Applications, Session 27, Midcon/77 Electron Show and Conv., Chicago, Ill., November 8-10, 1977

This paper describes the unusual requirements for spacecraft computing and a resulting real-time distributed computer architecture which has been designed and implemented at the Jet Propulsion Laboratory. This system, designated the Unified Data System (UDS), has been implemented in a feasibility breadboard used to simulate onboard processing similar to a current planetary spacecraft.

The following aspects of the UDS network are described: 1) techniques for simplification, 2) the standardized computer elements, 3) a highly redundant bus structure which connects the various computers and facilitates communication with minimal software support, and 4) the structure of the software and local executive residing within the various computers, and its coordination between modules.

R026 A Study of Standard Building Blocks for the Design of Fault-Tolerant Distributed Computer Systems

D. A. Rennels, A. Avizienis (University of California, Los Angeles), and
M. Ercegovic (University of California, Los Angeles)

Proc. Eighth Annu. Int. Conf. on Fault-Tolerant Computing, Toulouse, France, June 21-23, 1978, pp. 144-149

This paper presents the results of a study that has established a standard set of four semiconductor VLSI building-block circuits. These circuits can be assembled with off-the-shelf microprocessors and semiconductor memory modules into fault-tolerant distributed computer configurations. The resulting multi-computer architecture uses self-checking computer modules backed up by a limited number of spares. A redundant bus system is employed for communication between computer modules.

RENZETTI, N. A.

R027 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network Progress Report 42-43
November and December 1977, pp 1-3,
February 15, 1978

The objectives, functions, and organization of the Deep Space Network are summarized, deep space station, ground communication, and network operations control capabilities are described

R028 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network Progress Report 42-44
January and February 1978, pp 1-3, April 15,
1978

The objectives, functions, and organization of the Deep Space Network are summarized, deep space station, ground communication, and network operations control capabilities are described

R029 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network Progress Report 42-45
March and April 1978, pp 1-3, June 15, 1978

The objectives, functions, and organization of the Deep Space Network are summarized, deep space station, ground communication, and network operations control capabilities are described

R030 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network Progress Report 42-46
May and June 1978, pp 1-3, August 15, 1978

The objectives, functions, and organization of the Deep Space Network are summarized, deep space station, ground communication, and network operations control capabilities are described

R031 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network Progress Report 42-47
July and August 1978, pp 1-3, October 15, 1978

The objectives, functions, and organization of the Deep Space Network are summarized, deep space station, ground communication, and network operations control capabilities are described

R032 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network Progress Report 42-48
September and October 1978, pp 1-3,
December 15, 1978

The objectives, functions, and organization of the Deep Space Network are summarized, deep space station, ground communication, and network operations control capabilities are described

RESCH, G. M.

R033 Microwave Radiometer Measurement of Water Vapor Path Delay: Data Reduction Techniques

E. S. Claflin, S. C. Wu, and G. M. Resch

The Deep Space Network Progress Report 42-48
September and October 1978, pp 22-30,
December 15, 1978

For abstract, see Claflin, E. S.

REY, R. D.

R034 Network Telemetry System Performance Tests in Support of the Mark III Data System Implementation

R. D. Rey and E. J. Nipper

The Deep Space Network Progress Report 42-45
March and April 1978, pp 294-301, June 15,
1978

This article presents a description of Network Telemetry System Performance Tests that were executed throughout the DSN in support of the Mark III Data System Implementation

REYNOLDS, S. M.

R035 MBASIC™ Batch Processor Architectural Overview

S. M. Reynolds

The Deep Space Network Progress Report 42-48
September and October 1978, pp 82-86,
December 15, 1978

The MBASIC™ Batch Processor will allow users to run MBASIC™ programs more cheaply. It will be provided as a CONVERT TO BATCH command, usable from the ready mode. It will translate the users program in stages through several levels of intermediate language and optimization. Only the final stage is machine dependent, therefore, only a small effort will be needed to provide a Batch Processor for a new machine.

RHIM, W. K.

R036 Calculation of Spin-Lattice Relaxation During Pulsed Spin Locking in Solids

W. K. Rhim, D. P. Burum (California Institute of Technology), and D. D. Elleman

J Chem Phys, Vol 68, No 2, pp 692-695, January 1978

The spin-lattice relaxation time has been calculated for dipolar solids when the spins are locked by an rf pulse sequence with pulses of arbitrary angle and finite width. Expressions are given for the homonuclear case in general and for the heteronuclear case in the δ -function limit. The results for the homonuclear case are experimentally confirmed using solid C_6F_{12} . The analysis shows that for small pulse angles, at which the direct spin heating effect is known to be small, the relaxation behavior will be identical to the cw irradiation case.

R037 A Multiple Pulse Zero Crossing NMR Technique, and Its Application to ^{19}F Chemical Shift Measurements in Solids

D. P. Burum (California Institute of Technology), D. D. Elleman, and W. K. Rhim

J Chem Phys, Vol 68, No 3, pp 1164-1169, February 1978

For abstract, see Burum, D. P.

R038 New Technique for Single-Scan T_1 Measurements Using Solid Echoes

D. P. Burum, D. D. Elleman, and W. K. Rhim

Rev Sci Instrum, Vol 49, No 8, pp 1169-1175, August 1978

For abstract, see Burum, D. P.

RICE, R. F.

R039 Potential End-to-End Imaging Information Rate Advantages of Various Alternative Communication Systems

R. F. Rice

JPL Publication 78-52, June 15, 1978

This paper addresses a specific communication system problem which has characterized planetary exploration but which also appears in other applications. The results provide a new means of comparing the efficiency of various communication systems which are required to transmit *both* imaging and a typically error sensitive class of data called general science/engineering (gse) over a Gaussian channel. The approach jointly treats the imaging and gse transmission problems, allowing comparisons

of systems which include various channel coding and data compression alternatives. Actual system comparisons include an "Advanced Imaging Communication System" (AICS) which exhibits the rather significant potential advantages of sophisticated data compression coupled with powerful yet practical channel coding.

R040 RPV Application of a Globally Adaptive Rate Controlled Compressor

R. F. Rice

JPL Publication 78-61, July 15, 1978

This paper introduces a globally adaptive image compression structure for use in a tactical RPV environment. The structure described would provide an operator with the flexibility to dynamically maximize the usefulness of a limited and changing data rate. The concepts would potentially simplify system design while at the same time improving overall system performance.

Prepared for the U.S. Army Aviation Research and Development Command.

RIUS, A.

R041 S-Band Maser Phase Delay Stability Tests

J. M. Urech, F. Alcazar, J. Galvez, A. Rius, and C. A. Greenhall

The Deep Space Network Progress Report 42-48
September and October 1978, pp 102-117,
December 15, 1978

For abstract, see Urech, J. M.

ROCKWELL, G. M.

R042 Helios Mission Support

P. S. Goodwin and G. M. Rockwell

The Deep Space Network Progress Report 42-43
November and December 1977, pp 24-28,
February 15, 1978

For abstract, see Goodwin, P. S.

R043 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and G. M. Rockwell

The Deep Space Network Progress Report 42-44
January and February 1978, pp 50-53, April 15,
1978

For abstract, see Goodwin, P. S.

R044 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and
G. M. Rockwell

The Deep Space Network Progress Report 42-45
March and April 1978, pp 101-103, June 15,
1978

For abstract, see Goodwin, P S

R045 Helios Mission Support

P S. Goodwin, G. M. Rockwell, and
W. N. Jensen

The Deep Space Network Progress Report 42-46
May and June 1978, pp 37-39, August 15, 1978

For abstract, see Goodwin, P S

R046 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and
G. M. Rockwell

The Deep Space Network Progress Report 42-47
July and August 1978, pp 26-28, October 15,
1978

For abstract, see Goodwin, P S

R047 Helios Mission Support

P. S. Goodwin, W. N. Jensen, and
G. M. Rockwell

The Deep Space Network Progress Report 42-48
September and October 1978, pp 15-17,
December 15, 1978

For abstract, see Goodwin, P S

ROCKWELL, R. S

R048 An Empirical Spectral Bandwidth Model for Superior Conjunction

R. S. Rockwell

The Deep Space Network Progress Report 42-43
November and December, 1977, pp 216-223,
February 15, 1978

The downlink signal from spacecraft in superior solar conjunction phases suffers a great reduction in signal-to-noise ratio. Responsible in large part for this effect is the line broadening of the signal spectrum. This article presents an analytic empirical expression for spectral bandwidth as a function of heliocentric distance from 1 to 20 solar radii. The study is based on spectral broadening data obtained from the superior conjunctions of Helios 1 (1975), Helios 2 (1976) and Pioneer 6 (1968). The empirical fit is based in part on a function describing the electron content in the solar corona.

RODEMICH, E. R.

R049 The Lovasz Bound and Some Generalizations

R. J. McEliece, E. R. Rodemich, and
H. C. Rumsey, Jr.

The Deep Space Network Progress Report 42-45
March and April 1978, pp 133-146, June 15,
1978

For abstract, see McEliece, R. J

R050 A Probabilistic Version of Sperner's Theorem, With Applications to the Problem of Retrieving Information From a Data Base

L. D. Baumert, R. J. McEliece,
E. R. Rodemich, and H. Rumsey, Jr.

The Deep Space Network Progress Report 42-46
May and June 1978, pp 81-86, August 15, 1978

For abstract, see Baumert, L. D

ROHATGI, N. K.

R051 Ultraviolet Absorption Cross Sections of Hydrogen Peroxide

C. L. Lin, N. K. Rohatgi, and W. B. DeMore

Geophys Res Lett, Vol 5, No 2, pp 113-115,
February 1978

For abstract, see Lin, C L.

ROSCHKE, E. J.

R052 Application of the Relative Energy Release Criteria to Enclosure Fire Testing

E. J. Roschke and C. D. Coulbert

JPL Publication 78-86, January 1, 1978

The Relative Energy Release Criteria (RERC) are a first step towards formulating a unified concept that can be applied to the development of fires in enclosures. The five criteria place upper bounds on the rate and amount of energy released during a fire. They are independent, calculated readily, and may be applied generally to any enclosure regardless of size. They are useful in pretest planning and for interpreting experimental data.

In this report, data from several specific fire test programs have been examined to evaluate the potential use of RERC to provide test planning guidelines. The RERC were compared with experimental data obtained in full-scale enclosures by Stanford Research Institute and Lawrence Livermore Laboratory. These results confirm that in general the RERC do identify the proper limiting constraints on enclosure fire development and determine

the bounds of the fire development envelope. Plotting actual fire data against the RERC reveals new valid insights into fire behavior and reveals the controlling constraints in fire development. Also, in this report, the RERC were calculated and plotted for several descriptions of full-scale fires in various aircraft compartments.

ROSEBORO, J. A.

R053 Effect of Ultrasonic Irradiation of Mammalian Cells and Chromosomes *in vitro*

J. A. Roseboro, P. Buchanan (University of North Carolina, Chapel Hill), A. Norman (University of California, Los Angeles), and R. Stern (University of California, Los Angeles)

Phys Med Biol, Vol 23, No 2, pp 324-331, 1978

Human peripheral blood and HeLa cells were irradiated *in vitro* at the ultrasonic frequency of 65 kHz. The whole blood and HeLa cell suspensions were exposed to continuous and pulsed ultrasonic power levels of 0.12, 0.16, 0.72, 1.12 and 2.24 W for a period of one minute. The method of ultrasonic irradiation was carried out with the whole blood or HeLa cell suspensions coupled directly to a cylindrical transducer while heating of the cell suspensions in excess of 41°C was avoided. Irradiated and unirradiated peripheral blood lymphocyte chromosome cultures were prepared and scored for selected numerical and morphological aberrations. There was no significant difference in the frequency of chromosomal aberrations between irradiated and unirradiated cells. The fraction of cells *S* surviving after an exposure to an ultrasound dose of *D* can be represented by $S = \exp(-D/D_0)$. Further, D_0 is shown to depend on the time after exposure at which survival is assayed.

ROSENBERG, R. L.

R054 Observations of the Interplanetary Sector Structure up to Heliographic Latitudes of 16°: Pioneer 11

E. J. Smith, B. T. Tsurutani, and R. L. Rosenberg (University of California, Los Angeles)

J Geophys Res, Vol 83, No A2, pp 717-724, February 1, 1978

For abstract, see Smith, E. J.

ROTH, L. E.

R055 Equipotential Daming in Flooded Circular Basins on the Moon

L. E. Roth, C. Elachi, and R. J. Phillips

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 643-654

A procedure is presented that permits determination of the shape of the gravity field due to an arbitrary mass configuration with circular symmetry. The procedure is used to model the shape of the field associated with the lunar circular basins. The mean slopes of the equipotential surfaces generated by a superisostatic deposit corresponding to a near-surface Crisium-size mascon are calculated to fall within the range from 1.700 to 1.1000, those generated by a mantle rebound of the same excess mass, at 60 km below the lunar surface, cluster around the value of 1.1500.

ROZEK, J. B.

R056 An Effective Procurement and Financial Management Reporting System

J. B. Rozek and F. R. Maiocco

The Deep Space Network Progress Report 42-44 January and February 1978, pp 289-310, April 15, 1978

This article describes the existing computerized Goldstone Procurement and Financial (GPF) management data base system. Sample management analysis reports are included and discussed along with estimated cost savings and anticipated benefits of the computerized system. In general, the system structure and procedures contained in this article are relevant to any company's financial and procurement data acquisition and information handling system. Test data are used throughout this report to demonstrate the capability of the GPF system of programs.

RUBIN, A. L.

R057 FPLA Mechanization of Arithmetic Elements to Produce $A + B$ or to Pass A Only

D. E. Wallis, H. Taylor, and A. L. Rubin

The Deep Space Network Progress Report 42-46 May and June 1978, pp 76-80, August 15, 1978

For abstract, see Wallis, D. E.

RUIZ, R. M.

R058 IPL Processing of the Viking Orbiter Images of Mars

R. M. Ruiz, D. A. Elliott, G. M. Yagi, R. B. Pomphrey, M. A. Power, K. W. Farrell, Jr., J. J. Lorre, W. D. Benton, R. E. Dewar, and L. E. Cullen

J Geophys Res, Vol 82, No 28, pp 4189-4202, September 30, 1977

The Viking orbiter cameras returned over 9000 images of Mars during the 6-month nominal mission. Digital image processing was required to produce products suitable for quantitative and qualitative scientific interpretation. Processing included the production of surface elevation data using computer stereophotogrammetric techniques, crater classification based on geomorphological characteristics, and the generation of color products using multiple black-and-white images recorded through spectral filters. The Image Processing Laboratory of the Jet Propulsion Laboratory was responsible for the design, development, and application of the software required to produce these "second-order" products.

RUMSEY, H., JR.

- R059 A Probabilistic Version of Sperner's Theorem, With Applications to the Problem of Retrieving Information From a Data Base**

L. D. Baumert, R. J. McEliece,
E. R. Rodemich, and H. Rumsey, Jr.

The Deep Space Network Progress Report 42-46
May and June 1978, pp 81-86, August 15, 1978

For abstract, see Baumert, L. D.

RUMSEY, H. C., JR.

- R060 The Lovasz Bound and Some Generalizations**

R. J. McEliece, E. R. Rodemich, and
H. C. Rumsey, Jr.

The Deep Space Network Progress Report 42-45
March and April 1978, pp 133-146, June 15, 1978

For abstract, see McEliece, R. J.

RUSSELL, C. T.

- R061 On a Correlation Between Surface Remanent Magnetism and Chemistry for the Lunar Frontside and Limbs**

A. E. Metzger, R. P. Lin (University of California, Berkeley), and C. T. Russell (University of California, Los Angeles)

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp 1187-1190

For abstract, see Metzger, A. E.

RUSSELL, G. R.

- R062 Long-Duration High-Efficiency Operation of a Continuously Pulsed Copper Laser Utilizing Copper Bromide as a Lasant**

C. J. Chen, A. M. Bhanji, and G. R. Russell

Appl Phys Lett, Vol 33, No 2, pp 146-148, July 15, 1978

For abstract, see Chen, C. J.

- R063 A Continuously Pulsed Copper Halide Laser with a Cable-Capacitor Blumlein Discharge Circuit**

N. M. Nerhiem, A. M. Bhanji, and G. R. Russell

IEEE J Quantum Electron, Vol QE-14, No 9, pp 686-693, September 1978

For abstract, see Nerhiem, N. M.

- R064 Scaling a Double-Pulsed Copper Chloride Laser to 10 mJ**

N. M. Nerheim, A. A. Vetter (California Institute of Technology), and G. R. Russell

J Appl Phys, Vol 49, No 1, pp 12-15, January 1978

For abstract, see Nerheim, N. M.

RYASON, P. R.

- R065 Hydrogen From the Solar Photolysis of Water**

P. R. Ryason

Energy Sources, Vol 4, No 1, pp 1-22, 1978

Photochemical methods of generating hydrogen from water by light of wavelengths greater than 185 nm are reviewed. Contrary to the commonly held opinion, solar water photodecomposition reactions are known. Both heterogeneous and homogeneous reactions have been described. Currently, the heterogeneous photolysis involving semiconductors as electrodes in photoelectrochemical cells is a very active field of research. Homogeneous photoredox reactions are also known to result in water oxidation and reduction. Of these, the Eu^{2+} photolysis occurs in the sea level solar range of wavelengths with a reasonably high quantum yield. Energy is not stored in this reaction, however, and a means to reduce the photo-oxidized Eu^{3+} is not yet in hand. Thermodynamic considerations suggest that the direct photoreduction of aqueous ions is not likely to occur in the visible or near ultraviolet range. Therefore, indirect routes must be sought for the half of the cycle that provides a reducing agent and generates oxygen from water. This half of the cycle is probably the crucial one and repre-

sents a central problem in photochemical solar energy conversion

R066 New Method of Feeding Coal: Continuous Extrusion of Fully Plastic Coal

P. R. Ryason and C. England

Fuel, Vol 57, pp 241-244, April 1978

Continuous feeding of coal in a compressing screw extruder is described as a method of introducing coal into pressurized systems. The method utilizes the property of many bituminous coals of softening at temperatures from 350 to 400°C. Coal is then fed much in the manner of common thermoplastics, using screw extruders. Preliminary results show that coals can be extruded at rates of about 3.3 kg/MJ, similar to those for plastics.

SALAMA, A. M.

S001 The Effects of Copper and Titanium on Silicon Solar Cells

A. M. Salama

Conf Rec Thirteenth IEEE Photovoltaic Spec Conf, Washington, D C, June 5-8, 1978, pp 496-502

Copper-doped N/P silicon solar cells fabricated from Czochralski grown single-crystal wafers were found to have good electrical characteristics, but the titanium-doped N/P silicon solar cells had considerably lower conversion efficiency. However, in the copper/titanium-doped solar cells, copper seems to mitigate the unfavorable effects of titanium.

To explain this behavior, microstructural tests were performed on silicon wafers and solar cells doped with copper, titanium and copper/titanium. Dark forward and reverse I-V measurements were performed on the solar cells to correlate the microstructural defects with the p-n junction properties.

It was found that copper precipitates were formed in the copper-doped and copper/titanium-doped wafers and cells. There was a significant voltage drop in the dark reverse I-V measurements of the titanium solar cells. Also, there were some electrically active defects in the depletion region of some titanium-doped cells. Reasons that lead to the above results are given in detail.

SAROHIA, V.

S002 Pressure Pulsations on a Flat Plate Normal to an Underexpanded Supersonic Jet

L. H. Back and V. Sarohia

AIAA J, Vol 16, No 6, pp 634-636, June 1978

For abstract, see Back, L. H.

SAUNDERS, R. S.

S003 A TiO₂ Abundance Map for the Northern Maria

T. V. Johnson, R. S. Saunders,
D. L. Matson, and J. A. Mosher

Proc Eighth Lunar Sci Conf, Houston, Tex, March 14-18, 1977, pp. 1029-1036

For abstract, see Johnson, T. V.

S004 Venus' Geologic Analysis of Radar Images

R. S. Saunders and M. C. Malin

Proc Int Colloq Planet Geol, Rome, Italy, September 22-30, 1975, pp 507-515

Recent radar images of the surface of Venus reveal a complex and varied terrain. Few of the features can be uniquely identified owing to data constraints and ambiguity in determining the processes governing the radar return. If simplifying assumptions about the nature of surfaces returning the radar signal (e.g., that slopes and surface roughness on the order of the radar wavelength dominate the return), a number of plausible but speculative interpretations are possible. In one region on Venus, a large number of circular features have the gross morphology and size distribution of degraded impact craters on the cratered terrains of the Moon, Mars, and Mercury. This observation suggests that there exist on Venus areas which are ancient and where erosion or resurfacing has not been as intense or as pervasive as on Earth. In other regions, equally intriguing features occur in the radar images. One is a large trough-like depression (0°, -76° E, 1400 km × 150 km × 2 km). This valley is planimetrically suggestive of both the Valles Marineris on Mars and the East African rift on Earth, and may indicate extensional tectonic activity. Another feature, about 200 km in diameter and of positive relief, includes a 60 km diameter circular depression at its summit, suggestive of a large volcanic construct. A third region near 0°, 10° E contains roughly parallel ranges of mountains separated by valley-like features, with relief varying from small isolated hills of several hundred meters progressing to low ranges on the order of 1000 m to large mountains approaching 2 km of local relief. If Venus has a mobile crust similar to the Earth's, these mountains may be produced by compressional tectonics. Although these interpretations are quite tentative and continuing evaluation may change the feature classification significantly, the radar data suggest Venus to be a geologically active planet with diverse landforms, and an exciting candidate for future exploration.

SCHABER, G.

S005 Application of Multispectral Radar and LANDSAT Imagery to Geologic Mapping in Death Valley

M. Daily, C. Elachi, T. Farr, W. Stromberg, S. Williams, and G. Schaber (U S Geological Survey)

JPL Publication 78-19, March 30, 1978

For abstract, see Daily, M

SCHERER, K.

S006 Synthesis and Biological Screening of Novel Hybrid Fluorocarbon Hydrocarbon Compounds for Use as Artificial Blood Substitutes—Annual Report, July 1976–July 1977

J. Moacanin, K. Scherer, A. Toronto (Utah Biological Test Laboratory), D. Lawson, T. Terranova, L. Astle (Utah Biological Test Laboratory), and S. Harvey (Utah Biological Test Laboratory)

JPL Publication 77-80, January 15, 1978

For abstract, see Moacanin, J

SCHNEIDER, H.

S007 Automotive Technology Status and Projections: Executive Summary

M Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol I, June 1978

For abstract, see Dowdy, M

S008 Automotive Technology Status and Projections: Assessment Report

M. Dowdy, A Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft

JPL Publication 78-71, Vol II, June 1978

For abstract, see Dowdy, M

SCHOEN, R.

S009 A Southern California Gas Company Project SAGE Report—Selected U.S. Building Industry Processes and Characteristics

R. Schoen (University of California, Los Angeles)

JPL Publication 77-48, January 1978

Selected multifamily processes are examined (using a primarily graphic approach) to clarify some of the operational modes into which Project SAGE (solar-assisted gas energy) must fit, both as a product and a process in the U S building industry

What SAGE must have or “do” in order to fit the building industry in the short term (that is, the multifamily submarket as it is presently configured) is delineated in the report

Prepared for the Southern California Gas Company

S010 A Southern California Gas Company Project SAGE Report—Utilization Requirements

R. Schoen (University of California, Los Angeles) and A. S. Hirshberg

JPL Publication 77-49, January 1978

Utilization Requirements and comparisons of two Phase III SAGE installations in California 1) a retrofit installation in an existing apartment building in El Toro and 2) an installation in a new apartment building in Upland are the basis of this report Such testing in the field reveals the requirements which must be met if SAGE-type installations are to become commercially practical on a widespread basis in electric and gas energy usage

Prepared for the Southern California Gas Company

SCHWARTZ, A. A.

S011 Viking 1975 Mars Lander Interactive Computerized Video Stereophotogrammetry

S Liebes, Jr. (Stanford University) and A. A. Schwartz

J Geophys Res, Vol 82, No 28, pp 4421–4429, September 30, 1977

For abstract, see Liebes, S, Jr

SCHWARTZ, R. L.

S012 The DSN Standard Real-Time Language

R. L. Schwartz, G. L. Fisher, and R. C. Tausworthe

The Deep Space Network Progress Report 42-44
January and February 1978, pp 131–138,
April 15, 1978

A set of requirements for the Deep Space Network Standard Real-Time Language has been recently drafted This language will be a modern high-order programming language well-suited to the special needs of real-time

programs developed for use in the Deep Space Stations and Network Operations and Control Center. Nearly all DSN real-time programming has, in the past, been done using assembly language. The implementation of a standard high-order language is being planned in order to promote the development of real-time programs with higher reliability, increased programmer productivity, language commonality, flexibility, and re-use potential, and to provide a means for reducing the current life-cycle costs of DSN software.

S013 Parallel Compilation. A Design and Its Application to SIMULA 67

R. L. Schwartz

Comput Lang, Vol 3, pp 75-94, 1978

A design for a separate compilation facility for the SIMULA 67 programming language is presented. The paper explores the problems with existing separate compilation schemes, and proposes a new scheme that allows top-down, bottom-up, or even parallel development and integration of program modules. An evaluation of the proposal and a discussion of its applicability to other languages are then given.

SEIDEL, B.

S014 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography: Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle, E. Christensen, D. Farless, J. Mehta, B. Seidel, W. Michael, Jr. (Langley Research Center), A. Wallio (Langley Research Center), and M. Grossi (Raytheon Company)

J Geophys Res, Vol 82, No 28, pp 4317-4324, September 30, 1977

For abstract, see Fjeldbo, G

SEIDEL, B. L.

S015 Absolute Flux Density Calibrations: Receiver Saturation Effects

A. J. Freiley, J. E. Ohlson, and B. L. Seidel

The Deep Space Network Progress Report 42-46
May and June 1978, pp 123-129, August 15, 1978

For abstract, see Freiley, A. J

SERHAL, E. J., JR.

S016 DSN Portable Zero Delay Assembly

E. J. Serhal, Jr. and T. Y. Otoshi

The Deep Space Network Progress Report 42-46
May and June 1978, pp 130-138, August 15, 1978

This article presents design and test data on portable zero delay assemblies that have recently been delivered to DSS 14, 43, and 63. These portable assemblies are field-use delay standards that will be used to periodically calibrate the Block IV Translator ranging paths at each 64-m antenna Deep Space Station.

SHAFFER, D. B.

S017 The Compact Radio Sources in 4C 39.25 and 3C 345

D. B. Shaffer, et al.

Astrophys J, Vol 218, pp 353-360, December 1, 1977

Long-baseline interferometry of the quasars 4C 39.25 and 3C 345 at 10.65 and 14.77 GHz shows that the centimeter radio source in each object is double, with component separations of 0.0020 seconds (4C 39.25) and 0.0013 seconds (3C 345 at 1974.5). For each source, the separation is the same at both frequencies, as well as similar to the structure observed at 7.85 GHz (and 5.0 GHz for 4C 39.25). The spectra of the individual components are derived, and shown to vary with time approximately as expected for expanding self-absorbed synchrotron sources. The magnetic fields in the components are estimated to be as high as 0.1 gauss, but the structure of the sources appears to be unrelated to the magnetic field orientation derived from low-resolution polarization measurements. The component separation in 4C 39.25 has not changed for several years, whereas 3C 345 shows rapid expansion.

Contributors to this article include

National Radio Astronomy Observatory: D. B. Shaffer, K. I. Kellerman, and G. H. Purcell

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Owens Valley Radio Observatory: R. T. Schilizzi, M. H. Cohen, A. T. Moffet, and J. D. Romney

Jet Propulsion Laboratory: A. E. Niell

SHEARER, J. B.

S018 A Property of Euclid's Algorithm and an Application to Pade Approximation

R. J. McEliece and J. B. Shearer

SIAM J Appl Math, Vol 34, No 4, pp 611-615,
June 1978

For abstract, see McEliece, R. J

SHENK, W.

S019 Dust Storms: Great Plains, Africa, and Mars

P. M. Woiceshyn, R. Krauss (University of Wisconsin, Madison), R. Minzner (Goddard Space Flight Center), and W. Shenk (Goddard Space Flight Center)

Proc Tenth AMS Conf Severe Local Storms, Omaha, Neb., October 18-21, 1977, pp 495-496

For abstract, see Woiceshyn, P. M

SHUMATE, M. S.

S020 The Airborne Laser Absorption Spectrometer: A New Instrument for Remote Measurement of Atmospheric Trace Gases

M. S. Shumate and R. T. Menzies

Fourth Joint Conf Sensing of Environ Pollutants Conf Proc., New Orleans, La., November 6-11, 1977, pp 420-422

The Laser Absorption Spectrometer is a portable instrument developed by JPL to remotely measure trace gases from an aircraft platform. It contains two carbon dioxide lasers, two optical heterodyne receivers, appropriate optics to aim the lasers at the ground and detect the backscattered energy, and signal processing and recording electronics. Operating in the differential absorption mode, it is possible to monitor one atmospheric gas at a time, and record the data in real time. The system can presently measure ozone, ethylene, water vapor, and CFMs with high sensitivity. Airborne measurements were made in early 1977 from the NASA/JPL twin-engine Beechcraft, and in May 1977 from the NASA Convair 990 during the ASSESS-II Shuttle Simulation Study. These flights resulted in measurements of ozone concentrations in the lower troposphere which were compared with ground-based values provided by the Air Pollution Control District. This paper will describe the details of the instrument and results of the airborne measurements.

S021 Tropospheric Ozone Distributions Measured With an Airborne Laser Absorption Spectrometer

R. T. Menzies and M. S. Shumate

J Geophys Res, Vol 83, No C8, pp 4039-4043, August 20, 1978

For abstract, see Menzies, R. T

SHUMKA, A.

S022 Some Failure Modes and Analysis Techniques for Terrestrial Solar Cell Modules

A. Shumka and K. H. Stern

Conf Rec Thirteenth IEEE Photovoltaic Spec Conf., Washington, D C., June 5-8, 1978, pp 824-834

This paper describes the types of failure modes observed in failed/defective silicon solar cell modules of various types and procured from different manufacturers. This paper also describes analytical techniques that are particularly useful diagnostic tools for performing failure analysis.

SIDWELL, L. B.

S023 Results of the 1974 Through 1977 NASA/JPL Balloon Flight Solar Cell Calibration Program

L. B. Sidwell

JPL Publication 77-82, January 15, 1978

The Jet Propulsion Laboratory has been calibrating solar cells on high-altitude balloons since 1962. This report covers the flights from 1974 through 1977. During this time, seven solar cell calibration flights and two R&D flights with a spectroradiometer as a payload were attempted. There were two R&D flights, and one calibration flight that failed. Each calibration flight balloon was designed to carry its payload to an altitude of 36.6 km (120 kft). R&D flight balloons were designed for a payload altitude of 47.5 km (150 kft). At the end of the flight period, the upper (solar cell calibration system) and lower (consolidated instrument package [CIP]) payloads are separated from the balloon and descend via parachutes. The calibrated solar cells recovered in this manner are used as primary intensity reference standards during solar simulator testing of solar cells and solar arrays with similar spectral response characteristics. This method of calibration has become the most widely accepted technique for developing space standard solar cells.

The flights were conducted by NASA/JPL with the cooperation and assistance of the National Science Foundation's National Scientific Balloon Facility operated by the National Center for Atmospheric Research (NCAR) and located in Palestine, Texas.

SIEGEL, H. L.

S024 A Demonstration of Differenced Dual-Station One-Way Doppler Conducted with Pioneer 11

C. C. Chao, V. J. Ondrasik, and H. L. Siegel

The Deep Space Network Progress Report 42-45
March and April 1978, pp 104-110, June 15,
1978

For abstract, see Chao, C C

**S025 Δ VLBI Spacecraft Tracking System Demonstration:
Part I. Design and Planning**

D. L. Brunn, R. A. Preston, S. C. Wu,
H. L. Siegel, D. S. Brown C. S. Christensen, and
D E. Hilt

The Deep Space Network Progress Report 42-45
March and April 1978, pp 111-132, June 15,
1978

For abstract, see Brunn, D L

SIEVERS, M.

**S026 An Algorithm for Generating an m -ary Summation
Tree**

M. Sievers

The Deep Space Network Progress Report 42-45
March and April 1978, pp 147-151, June 15,
1978

An algorithm is presented for generating an m -ary summation tree. The algorithm is completely general and may be applied to any length input string. For an N length sequence summed in groups of m_l at each level l , a maximum of $3L - 2$ storage is required where L is the depth of the tree.

A special case of the general m -ary tree where all m_l are equal will be used to smooth data in a radio-frequency interference experiment. The maximum storage required when $m_l = m$ for all l reduces to the closed form $3 \log_m N - 2$.

SIMON, M. K.

**S027 The False Lock Performance of Costas Loops With
Hard-Limited In-Phase Channel**

M. K. Simon

IEEE Trans Commun, Vol COM-26, No 1, pp
23-34, January 1978

The ability of a Costas loop to false lock on a data sideband is a problem which must be dealt with in the design of suppressed-carrier receivers which employ such loops for carrier reconstruction. For conventional Costas loops wherein the error signal is formed from the product of two analog signals, the false lock problem has recently been investigated by the author and others and is now well understood. For implementation reasons

associated with the reduction of dc offsets, it is often desirable to hard limit the output of the in-phase channel and replace the analog multiplier which forms the above product with a chopper-type device. The false lock behavior of such a Costas loop with hard-limited in-phase channel is quite different from that of the conventional Costas loop and is the subject of investigation in this paper. Results are also presented for a modified version of the Costas loop wherein the quadrature arm filter is removed. This configuration has recently been suggested as a means of improving the false lock performance of the Costas loop with hard-limited in-phase channel.

**S028 On the Calculation of Squaring Loss in Costas
Loops With Arbitrary Arm Filters**

M. K. Simon

IEEE Trans Commun, Vol COM-26, No 1, pp
179-184, January 1978

The calculation of the optimum performance of suppressed carrier receivers with Costas loop tracking is directly related to evaluating the loop's so-called *squaring loss*. Recent work by the author and others presented specific numerical results for this loss when the input data were biphasic-L (Manchester coded) and the Costas loop arm filters were of the n -pole Butterworth type. These results were largely obtained by numerical integration on a digital computer. This paper presents a partial fraction expansion technique for arriving at closed form expressions for squaring loss for Costas loops with arbitrary arm filters and NRZ as well as Manchester coded data. Specific closed form results are given for one and two pole Butterworth filters as examples.

**S029 Tracking Performance of Costas Loops With Hard-
Limited In-Phase Channel**

M. K. Simon

IEEE Trans Commun, Vol COM-26, No 4, pp
420-432, April 1978

It is becoming increasingly popular in the design of suppressed carrier receivers, which employ Costas loops for carrier reconstruction, to hard-limit the output of the in-phase channel. Doing so allows replacement of the analog multiplier, which forms the loop error signal, with a chopper-type device which typically exhibits much less dc offset. The false lock behavior of such a hard-limited loop was recently investigated and shown to be quite different from that of the conventional Costas loop without the hard limiter. This paper presents the companion analysis of the tracking performance of the hard-limited loop and assesses the penalty, if indeed it is a penalty rather than an improvement, in this performance relative to the conventional Costas loop with an analog third multiplier. In particular, for the case of RC arm filters and NRZ data, the squaring loss (or equiva-

lently the linear loop tracking jitter) is evaluated and illustrated as a function of the ratio of arm filter bandwidth to data rate and data signal-to-noise ratio. Superimposed on these numerical results will be the corresponding ones for the conventional Costas loop. As a finale, the equivalence in operation of the Costas loop with hard-limited in-phase channel and a baseband modulation carrier reconstruction loop referred to as a demod/remod loop is discussed.

SIMPSON, J. A.

S030 The Energetic Particle Environment of the Solar Probe Mission—As Estimated by the Participants in the Solar Probe Environment Workshop

M. Neugebauer, L. A. Fisk, R. E. Gold, R. P. Lin, G. Newkirk, J. A. Simpson, and M. A. I. Van Hollebeke

JPL Publication 78-64, September 1, 1978

For abstract, see Neugebauer, M

SINES, G.

S031 A Statistical, Micromechanical Theory of the Compressive Strength of Brittle Materials

M. Adams and G. Sines

J Amer Ceram Soc, Vol. 61, No 3-4, pp 126-131, March-April 1978

For abstract, see Adams, M

S032 Crack Extension From Flaws in a Brittle Material Subjected to Compression

M. Adams and G. Sines

Tectonophysics, Vol 49, pp 97-118, 1978

For abstract, see Adams, M

SJOGREN, W. L.

S033 The Isostatic State of the Lunar Apennines and Regional Surroundings

A. J. Ferrari, D. L. Nelson (California Institute of Technology), W. L. Sjogren, and R. J. Phillips

J Geophys Res, Vol 83, No B6, pp 2863-2871, June 10, 1978

For abstract, see Ferrari, A J

S034 An Improved Lunar Moment of Inertia Determination: A Proposed Strategy

M. P. Ananda, A. J. Ferrari, and W. L. Sjogren

Moon, Vol 17, pp 101-120, 1977

For abstract, see Ananda, M P

SLADE, M.

S035 Planetary Benchmarks

C. Uphoff, R. Staehle, M. Kobrick, R. Jurgens, H. Price, M. Slade, and D. Sonnabend

JPL Publication 78-94, December 1, 1978

For abstract, see Uphoff, C

SLOBIN, S. D.

S036 DSN Water Vapor Radiometer Development—Recent Work, 1978

P. D. Batelaan and S. D. Slobin

The Deep Space Network Progress Report 42-48 September and October 1978, pp 129-135, December 15, 1978

For abstract, see Batelaan, P D

SLONSKI, M. L.

S037 Potential for Cogeneration of Heat and Electricity in California Industry—Phase I: Final Report

H. S. Davis, R. M. Gurfield, V. C. Moretti, and M. L. Slonski

JPL Publication 78-42, May 1, 1978

For abstract, see Davis, H S

SMITH, A. Y.

S038 An Interactive Lake Survey Program

A. Y. Smith and J. D. Addington

Proc SPIE, Vol 119, pp 21-27, 1977

The need exists to find a means of rapidly assessing the trophic state of water bodies which would make it economically feasible to operate extensive systematic surveillance programs of the water resources in the United States. Airborne multispectral sensors show promise as a means of monitoring these resources on a continuous basis. The Image Processing Laboratory at the Jet Propulsion Laboratory (JPL) in conjunction with the Environmental Protection Agency has been involved in water quality studies for the past five years. During this time the primary aim has been to demonstrate the feasibility of applying remotely sensed data to water quality assessment. The experience and technology developed at JPL

has now been coalesced into an interactive lake survey program

SMITH, C. A

S039 A Review of the State of the Art in Large Spaceborne Antenna Technology

C. A. Smith

JPL Publication 78-88, November 15, 1978

This report studies three classes of antennas (reflectors, lenses, and arrays) with a view toward their use as extremely large space antennas. RF performance characteristics, weight, manufacturing complexity, and cost are discussed for each class. Examples of antennas of each class which have been built or analyzed are described to give an appreciation of current and expected industry capability. Multibeam aspects are considered, and general characteristics of multibeam antennas are discussed. General guidelines are given for use of the appropriate class of antenna to meet certain performance requirements, and recommendations are made for future study. The reflector emerges as the optimum choice for most very large aperture applications, though the lens and array appear ideally suited for use as feeds for multibeam near-field Cassegrain or Gregorian designs.

SMITH, E. J.

S040 The ISEE-C Vector Helium Magnetometer

A. M. A. Frandsen, B. V. Connor,
J. Van Amersfoort, and E. J. Smith

IEEE Trans Geosci Electron, Vol GE-16, No 3,
pp 195-198, July 1978

For abstract, see Frandsen, A. M. A

S041 Observations of the Interplanetary Sector Structure up to Heliographic Latitudes of 16° . Pioneer 11

E. J. Smith, B. T. Tsurutani, and
R. L. Rosenberg (University of California, Los Angeles)

J Geophys Res, Vol 83, No A2, pp 717-724,
February 1, 1978

A study of the interplanetary sector structure at heliographic latitudes up to 16° N is reported. The study is based on magnetic field measurements made on board Pioneer 11 as the spacecraft traveled along the post-Jupiter-encounter trajectory. Preliminary measurements are used to determine the dominant polarity of the interplanetary magnetic field during 43 successive solar rotations including Pioneer's ascent to its maximum latitude and motion inward from 5 to 3.7 AU. As the latitude of

Pioneer increased, the dominant polarity became continually more positive, corresponding to an outward-directed solar interplanetary field. When the spacecraft reached the highest latitude, the usual sector structure had essentially disappeared. A histogram of the field longitude angle, based on data acquired during 1 month at 16° latitude, shows an almost total absence of inward-directed fields. A comparison with interplanetary field polarities in the ecliptic, as inferred from geomagnetic field variations, rules out the possibility that a time variation rather than a latitude dependence is responsible. The Pioneer 11 observations imply that the boundary between adjacent sectors corresponds physically to a current sheet surrounding the sun and lying nearly parallel to the solar equatorial plane. Above this current sheet, in the northern hemisphere, the field polarity at this phase of the solar cycle is outward, and below the current sheet, in the southern hemisphere, it is inward. The Pioneer observations confirm earlier theoretical suggestions regarding the existence and equatorial orientation of this current sheet. The properties of the current sheet and some major implications and questions associated with it are discussed. It is shown that the radial component of the sheet current is compensated by the distributed currents in the northern and southern hemispheres associated with the spiraled interplanetary field.

S042 Pioneer 10, 11 Observations of Evolving Solar Wind Streams and Shocks Beyond 1 AU

E. J. Smith and J. H. Wolfe (Ames Research Center)

Study of Travelling Interplanetary Phenomena/1977 Proc L D de Feiter Memorial Symposium, Tel Aviv, Israel, June 7-10, 1977, pp 227-257

Observations between 1 and 5 AU by Pioneers 10 and 11 have led to the identification of large numbers of interplanetary shocks. Both forward and reverse shocks, which begin to develop beyond 1.5 AU and which frequently appear as shock pairs, are found to accompany solar wind streams. The number of forward shocks continues to increase out to at least 5 AU. Reverse shocks are seen less often than forward shocks and, in some instances, disappear at larger distances. There is evidence that the shocks are corotating in the solar frame, as anticipated theoretically. The evolution of solar wind streams beyond 1 AU is profoundly affected by the shocks. A thick interaction region, with large enhancements in density, temperature, field strength and fluctuation level, forms in the region originally characterized by a positive velocity gradient. The solar wind and magnetic field properties adjacent to, and within, the interaction regions have been studied to determine their qualitative behavior and characteristic changes with distance. Several interplanetary shocks generated by solar flares have also been identified and analyzed.

SMITH, E. K.

S043 Temperate Zone Sporadic-E Maps ($f_oE_s > 7$ MHz)

E. K. Smith

Radio Sci., Vol 13, No 3, pp 571-575, May-June 1978

Three maps are presented of $f_oE_s > 7$ MHz for temperate zones. During map preparation it was assumed that (1) the geographical area would be between $\pm 60^\circ$ geomagnetic latitude, excluding the equatorial zone, (2) the maps would be for $f_oE_s > 7$ MHz, (3) sunspot cycle variation would be ignored, (4) one map would represent the peak sporadic-E period with a discontinuity at the geographic equator, (5) one map would represent non-peak periods with a discontinuity at the geographic equator, (6) one map would represent all twelve months with no equatorial discontinuity, and (7) previously determined coefficients for median and upper decile f_oE_s would be extrapolated to 7 MHz.

SMITH, J. C.

S044 Visual and Infrared Photometry of Asteroids

G. J. Veeder, D. L. Matson, and J. C. Smith

Astron. J., Vol. 83, No 6, pp 651-663, June 1978

For abstract, see Veeder, G. J.

SMITH, J. L.

S045 Historical Evidence of Importance to the Industrialization of Flat-Plate Silicon Photovoltaic Systems: Executive Summary

J. L. Smith, W. R. Gates, and T. Lee

JPL Publication 78-36, Vol I, April 1978

This document summarizes the results of a study which analyzes the Low Cost Silicon Solar Array Project (LSSA) plans with respect to the industrialization (as opposed to commercialization) of new production technologies expected to be forthcoming as a result of the project's technology development efforts. In particular, LSSA's mandate to insure an annual production capability of 500 MW peak for the photovoltaic supply industry by 1986 is critically examined. The examination focuses on one of the concerns behind this goal—timely development of industrial capacity to supply anticipated demand. Conclusions from the analysis are utilized in a discussion of LSSA's industrialization plans, particularly the plans for pilot, demonstration, and commercial scale production plants. Specific recommendations for the implementation of an industrialization task and the disposition of the project quantity goal are derived.

Prepared for the Department of Energy, DOE/JPL-1012-78/1, Distribution Category UC-63

S046 Historical Evidence of Importance to the Industrialization of Flat-Plate Silicon Photovoltaic Systems

J. L. Smith, W. R. Gates, and T. Lee

JPL Publication 78-36, Vol II, April 1978

This report is intended to define, elucidate, and comment on problems which may arise as the Low Cost Silicon Solar Array (LSSA) Project attempts to industrialize (as opposed to commercialize) the new production technologies expected to be forthcoming as a result of the Technology Development efforts of the project. In particular, LSSA's charge to insure an annual production capability of 500 MW peak for the photovoltaic supply industry by 1986 is critically examined. The examination focuses on one of the motivations behind this goal—concern over the timely development of industrial capacity to supply anticipated demand. Conclusions from the analysis are then utilized in a discussion of LSSA's industrialization plans, particularly the plans for pilot, demonstration and commercial scale production plants. Specific recommendations for the implementation of an industrialization task and the disposition of the project quantity goal are derived.

Prepared for the Department of Energy, DOE/JPL-1012-78/1, Distribution Category UC-63

SMITH, L. D.

S047 Space Power Systems Technology Enablement Study

L. D. Smith and J. W. Stearns

JPL Publication 78-7, February 15, 1978

A study has been performed of the power systems technologies which are either enabling or enhancing for future missions requiring a few kilowatts or less and using the Shuttle. The U.S. Space Transportation System (STS), when properly utilized, will greatly expand our capabilities in space. The required advances in space power systems to support those capabilities have been systematically determined together with missions that are enabled and enhanced by the technologies identified. The analysis procedure employed benefit/cost/risk analyses to identify high payoff technologies and technological priorities.

SMITH, R. M.

S048 Some Data Relationships Among Diverse Areas of the DSN and JPL

R. M. Smith

The Deep Space Network Progress Report 42-44
January and February 1978, pp 260-267,
April 15, 1978

A logical-level data model is used to represent real-world relationships among diverse areas of the Deep Space Network (DSN) and non-DSN areas. The possibility for reduction of data redundancy is addressed.

SMOKLER, P. E.

S049 An Assessment of an F₂ or N₂O₄ Atmospheric Injection From an Aborted Space Shuttle Mission

R. T. Watson, P. E. Smokler, and W. B. DeMore
JPL Publication 77-81, April 15, 1978

For abstract, see Watson, R. T.

SNYDER, C. W.

S050 The Missions of the Viking Orbiters

C. W. Snyder

J Geophys Res, Vol 82, No 28, pp 3971-3983,
September 30, 1977

The two Viking orbiters carried the two landers into orbit around Mars, observed the planet to certify the landing sites, released the landers for the landings, and subsequently served as telemetry relays for the lander data. In addition, they conducted scientific investigations using two cameras, an infrared radiometer for temperature measurements, and infrared spectrometer for water vapor measurements, and the radio communication system. The nature and extent of the orbiter observations have been influenced by the requirements for lander support, the capabilities of various orbiter subsystems, and the visibility of the planet from the orbits. All the orbiter scientific experiments are continuing.

SOHA, J. M.

S051 Evaluation of Landsat MSS vs TM Simulated Data for Distinguishing "Hydrothermal Alteration"

M. J. Abrams, A. B. Kahle, D. P. Madura, and
J. M. Soha

JPL Publication 77-83, March 1, 1978

For abstract, see Abrams, M. J.

S052 Venus in Motion

J. L. Anderson, M. J. S. Belton (Kitt Peak
National Observatory), G. E. Danielson,
N. Evans, and J. M. Soha

Astrophys J Suppl Ser, Vol 36, No 2, pp 275-
284, February 1978

For abstract, see Anderson, J. L.

SOMOANO, R. B.

S053 Photoacoustic Spectroscopy of Condensed Matter

R. B. Somoano

Angew Chem Int Ed Engl, Vol 17, pp 238-
245, 1978

Photoacoustic spectroscopy is a new analytical tool that provides a simple nondestructive technique for obtaining information about the electronic absorption spectrum of samples such as powders, semisolids, gels, and liquids. It can also be applied to samples which cannot be examined by conventional optical methods. Numerous applications of this technique in the field of inorganic and organic semiconductors, biology, and catalysis have been described. Among the advantages of photoacoustic spectroscopy, the signal is almost insensitive to light scattering by the sample and information can be obtained about nonradiative deactivation processes. Signal saturation, which can modify the intensity of individual absorption bands in special cases, is a drawback of the method.

S054 Physics and Chemistry of MoS₂ Intercalation Compounds

J. A. Woollam (Lewis Research Center) and
R. B. Somoano

Mater Sci Eng, Vol 31, pp 289-295,
December 1977

For abstract, see Woollam, J. A.

S055 Photoacoustic Spectroscopy of Organometallic Compounds With Applications in the Fields of Quasi-One-Dimensional Conductors and Catalysis

R. B. Somoano, A. Gupta, W. Volksen,
A. Rembaum, and R. Williams (California Institute
of Technology)

Organometallic Polymers, pp 165-174, Academic
Press, Inc., New York, N. Y., 1978

The use of photoacoustic spectroscopy (PAS) to obtain information about the electronic absorption spectra of organometallic compounds is described. PAS is used to investigate the optical properties of (a) several quasi-one-dimensional rhodium metal complexes and (b) several transition metal catalysts which are immobilized on polymeric microsphere substrates. The PAS spectra reveal dramatic differences between highly conducting rhodium, polymeric chains and dimeric (and nonconducting) rhodium complexes. For the catalysts, the photoacoustic

spectra provide information concerning the degree of reduction of the transition metal and metal-ligand interactions which correlate with catalytic behavior

S056 Optical, Spin-Resonance, and Magnetoresistance Studies of (Tetrathiatetracene)₂(Iodide)₃. The Nature of the Ground State

R. B. Somoano, S. P. S. Yen, V. Hadek, S. K. Khanna, M. Novotny (Stanford University), T. Datta (Tulane University), A. M. Hermann (Tulane University), and J. A. Woollam (Lewis Research Center)

Phys Rev, Pt B Solid State, Vol 17, No 7, pp 2853-2857, April 1, 1978

Optical, spin resonance, and high-field magnetoresistance studies of the organic charge-transfer salt (tetrathiatetracene)₂(iodide)₃ [(TTT)₂I₃] have been carried out. This material is a single-carrier system consisting of segregated linear chains of TTT cation radicals and tri-iodide ions which are incommensurate with respect to each other. The I₃⁻ chains exhibit considerable disorder perpendicular to the chain axis. (TTT)₂I₃ has a high room-temperature conductivity $\sigma(300^\circ\text{K}) \sim 1000 \Omega^{-1} \text{ cm}^{-1}$ along the chain axis and is metallic down to $\sim 100^\circ\text{K}$ where a possible phase transition occurs. The nature of this transition is discussed. Below 30°K , (TTT)₂I₃ exhibits semiconducting properties indicating that the low-temperature ground state is nonmetallic.

S057 Electrical Properties of (DEPE) (TCNQ)₄

R. B. Somoano, V. Hadek, S. P. S. Yen, A. Rembaum, C. H. Hsu (California Institute of Technology), R. J. Deck (Tulane University), T. Datta (Tulane University), and A. M. Hermann (Tulane University)

Phys Stat Sol (B), Vol 81, No 1, pp 281-286, 1977

Conductivity measurements are performed on single crystals of two phases of (DEPE) (TCNQ)₄. Conductivities are determined by four probe and Montgomery methods, and the highest values measured are those along the *b*₀-axis for the monoclinic phase (I) crystals, $\approx 50 (\Omega \text{ cm})^{-1}$ at room temperature. The resistivities are in general exponentially activated (semiconducting behavior). Thermoelectric power measurements are performed along the *b*₀-axis of phase I crystals and the thermopower tends to saturate at high temperatures to $-60 \mu\text{V/K}$, characteristic of a quarter-filled correlated band. No evidence for the existence of a stable metallic state reported by Ashwell et al was found. The preliminary crystal structures of both phases are discussed.

S058 On the Crystal Phases of (DEPE) (TCNQ)₄

L. B. Coleman (University of California, Davis), A. M. Hermann (Tulane University), R. Williams (California Institute of Technology), and R. B. Somoano

Phys Stat Sol (B), Vol 82, No 2, pp K117-K121, 1977

For abstract, see Coleman, L. B.

SONNABEND, D.

S059 Planetary Benchmarks

C. Uphoff, R. Staehle, M. Kobrick, R. Jurgens, H. Price, M. Slade, and D. Sonnabend

JPL Publication 78-94, December 1, 1978

For abstract, see Uphoff, C.

SPRADLIN, G. L.

S060 Voyager Near Simultaneous Ranging Transfers

G. L. Spradlin

The Deep Space Network Progress Report 42-44 January and February 1978, pp 252-259, April 15, 1978

During testing of near simultaneous ranging techniques, a major shortcoming of the standard DSN uplink transfer procedure was uncovered. Use of the standard procedure resulted in loss of phase coherence between received and reference range codes for the round trip light time following a transfer. It is the intent of this article to report on the philosophy behind, and the operational procedure developed for near simultaneous range transfers, a new uplink transfer procedure that will enable the DSN to generate good range data during the interval from transmitter off to loss of the coherent downlink.

S061 Tracking Operations During the Voyager 2 Launch Phase

J. A. Wackley and G. L. Spradlin

The Deep Space Network Progress Report 42-44 January and February 1978, pp 273-288, April 15, 1978

For abstract, see Wackley, J. A.

SPRINGER, P.

S062 Ionizing Radiation Effects on SBP9900 Microprocessor

A. G. Stanley, W. Mallen, and P. Springer

IEEE Trans Nucl Sci, Vol NS-24, No 4, pp 1977-1978, August 1977

For abstract, see Stanley, A G

SRIVASTAVA, S. K.

S063 Electron-Impact Excitation of the Low-Lying Electronic States of HCN

A. Chutjian, H. Tanaka, B. G. Wicke (TRW Systems Group), and S. K. Srivastava

J Chem Phys, Vol 67, No 11, pp 4835-4839, December 1977

For abstract, see Chutjian, A

S064 Elastic Scattering of Intermediate Energy Electrons by HCN

S. K. Srivastava, H. Tanaka, and A. Chutjian

J Chem Phys, Vol 69, No 4, pp 1493-1497, August 15, 1978

Utilizing a crossed electron beam-molecular beam geometry and a relative gas flow technique, ratios $\sigma(\text{HCN}, \theta) / \sigma(\text{He}, \theta)$ of elastic differential cross sections of HCN to those of He have been measured at electron impact energies of 3, 5, 11.6, 21.6, and 50 eV and at scattering angles of 20° to 130° . Normalized absolute values of $\sigma(\text{HCN}, \theta)$ have been obtained by multiplying these ratios by the absolute values of $\sigma(\text{He}, \theta)$ reported previously. Since the rotational-vibrational structure in HCN was not resolved in the present measurements, the term elastic here includes contributions from elastic scattering, as well as from pure rotational and the $1-0$, ν_2 vibrational excitations. The elastic differential cross sections have been compared with the predictions of the Born approximations and classical perturbation theory. For angular regions lying between 0° and 20° , and 130° and 180° , $\sigma(\text{HCN}, \theta)$ values have been obtained by extrapolation. These values have been used to calculate the integral and momentum-transfer cross sections.

S065 Electron-Impact Cross Sections for Cu Atoms

S. Trajmar, W. Williams, and S. K. Srivastava

J Phys B At Mol Phys, Vol 10, No 16, 3323-3333, 1977

For abstract, see Trajmar, S

S066 Experimental Differential and Integral Electron Impact Cross Sections for the $B^1\Sigma_u^+$ State of H_2 in the Intermediate-Energy Region

S. K. Srivastava and S. Jensen (University of California, Riverside)

J Phys B At Mol Phys, Vol 10, No 16, pp 3341-3346, 1977

Utilizing a crossed electron-beam-molecular-beam scattering technique, differential electron impact cross sections (DCS) for the excitation of the $v' = 2$ vibrational band of the $B^1\Sigma_u^+$ state of H_2 have been measured and are presented for the first time. These measurements were made at electron impact energies of 15, 20, 30, 40, 50 and 60 eV. At each energy, DCS between scattering angles of 10° and 135° were determined. They were then extrapolated to 0° and 180° scattering angles to obtain the integral cross sections. These integral cross sections and the Frank-Condon factor for the $v' = 2$ band were used to calculate the total cross sections for the excitation of the $B^1\Sigma_u^+$ state.

SRIVASTAVAS, S. K.

S067 Electron Scattering by Highly Polar Molecules II. LiF

L. Vuskovic (Institute of Physics, Beograd, Yugoslavia), S. K. Srivastavas, and S. Trajmar

J Phys B At Molec Phys, Vol 11, No 9, pp 1643-1652, 1978

For abstract, see Vuskovic, L

STAEHLE, R.

S068 Planetary Benchmarks

C. Uphoff, R. Staehle, M. Kobrick, R. Jurgens, H. Price, M. Slade, and D. Sonnbend

JPL Publication 78-94, December 1, 1978

For abstract, see Uphoff, C

STANDISH, E. M., JR.

S069 Tests of General Relativity Using Astrometric and Radio Metric Observations of the Planets

J. D. Anderson, M. S. W. Keesey, E. L. Lau, E. M. Standish, Jr., and X. X. Newhall

Astronautica, Vol 5, pp 43-61, 1978

For abstract, see Anderson, J D

STANLEY, A. G.

S070 Voyager Electronic Parts Radiation Program: Test Requirements and Procedures

A. G. Stanley, K. E. Martin, and W. E. Price

JPL Publication 77-41, Vol II, December 15, 1978

Test requirements and procedures for the Voyager electronic parts radiation program are set forth in detail as Appendixes to JPL Publication 77-41, Volume I Together, the two volumes describe the program philosophy, radiation environment, device hardening efforts, and radiation test methods Test results of more than 200 device types are summarized in Volume I

S071 Ionizing Radiation Effects on SBP9900 Microprocessor

A. G. Stanley, W. Mallen, and P. Springer

IEEE Trans Nucl Sci, Vol NS-24, No. 4, pp 1977-1978, August 1977

The radiation resistance of a 16-bit microprocessor based on integrated injection logic technology has been investigated Cumulative fluences of 10^{12} to 10^{14} e/cm² were used in the radiation-resistance study Complete failure of the microprocessor was noted at a fluence level of 1.2×10^{14} e/cm² Though the radiation resistance of the microprocessor makes it suited for space applications, reductions in the power dissipation of the device are needed

S072 SEM Analysis of Ionizing Radiation Effects in Linear Integrated Circuits

A. G. Stanley and M. K. Gauthier

IEEE Trans Nucl Sci, Vol NS-24, No 6, pp 2060-2065, December 1977

A successful diagnostic technique was developed using a scanning electron microscope (SEM) as a precision tool to determine ionization effects in integrated circuits Previous SEM methods radiated the entire semiconductor chip or major areas The large area exposure methods do not reveal the exact components which are sensitive to radiation To locate these sensitive components a new method was developed, which consisted in successively irradiating selected components on the device chip with equal doses of electrons [10^6 rad (Si)], while the whole device was subjected to representative bias conditions A suitable device parameter was measured in situ after each successive irradiation with the beam off

STANTON, P. H.

S073 A Bandwidth Compressive Modulation System Using Multi-Amplitude Minimum Shift Keying (MAMSK)

W. J. Weber III, P. H. Stanton, and
J. T. Sumida

IEEE Trans Commun, Vol COM-26, No 5, pp 543-551, May 1978

For abstract, see Weber, W J III

STEARNS, J. W.

S074 Space Power Systems Technology Enablement Study

L. D. Smith and J. W. Stearns

JPL Publication 78-7, February 15, 1978

For abstract, see Smith, L. D

STERN, K. H.

S075 Some Failure Modes and Analysis Techniques for Terrestrial Solar Cell Modules

A. Shumka and K. H. Stern

Conf. Rec Thirteenth IEEE Photovoltaic Spec Conf, Washington, D C, June 5-8, 1978, pp 824-834

For abstract, see Shumka, A.

STERN, R.

S076 Effect of Ultrasonic Irradiation of Mammalian Cells and Chromosomes *in vitro*

J. A. Roseboro, P. Buchanan (University of North Carolina, Chapel Hill), A. Norman (University of California, Los Angeles), and R. Stern (University of California, Los Angeles)

Phys Med Biol, Vol 23, No 2, pp 324-331, 1978

For abstract, see Roseboro, J. A.

STEVENS, G. L.

S077 Three-Channel Integrating Analog-to-Digital Converter

G. L. Stevens

The Deep Space Network Progress Report 42-43
November and December 1977, pp 99-104,
February 15, 1978

A three-channel integrating analog-to-digital converter has been added to the complex mixer system It accepts the baseband, complex signals generated by the complex mixers and outputs binary data to the digital demodulator for further processing and recording It was first used for processing multistation data in radar experiments in the spring of 1977

STEWART, H. J.

S078 Proceedings of the Alternate Energy Systems Seminar

M. E. Alper, R. E. Bartera, H. S. Davis,
R. G. Forney, C. F. Mohl, H. J. Stewart, and
V. C. Truscello

JPL Publication 78-45, March 30, 1978

For abstract, see Alper, M. E.

STINNETT, W. G.

S079 DSN Command System Mark III-78

W. G. Stinnett

The Deep Space Network Progress Report 42-43
November and December 1977, pp. 4-8,
February 15, 1978

The DSN Command System Mark III-78 data processing includes a capability for a data handling method called "store-and-forward." A description of the data processing for command store-and-forward is contained in this article.

S080 DSN Monitor and Control System, Mark III-78

W. G. Stinnett

The Deep Space Network Progress Report 42-48
September and October 1978, pp. 4-6,
December 15, 1978

A description of the DSN Monitor and Control System, Mark III-78, is discussed. The major implementation required to evolve from the Mark III-75 to the Mark III-78 configuration is also discussed.

STIRN, R. J.

S081 A Schottky-Barrier Solar Cell on Sliced Polycrystalline GaAs

Y. C. M. Yeh and R. J. Stirn

Appl. Phys. Lett., Vol. 33, No. 5, pp. 401-403,
September 1, 1978

For abstract, see Yeh, Y. C. M.

S082 Progress Towards High Efficiency Polycrystalline Thin-Film GaAs AMOS Solar Cells

Y. C. M. Yeh, F. P. Ernest, and R. J. Stirn

Conf. Rec. Thirteenth IEEE Photovoltaic Spec. Conf.,
Washington, D. C., June 5-8, 1978, pp. 966-971

For abstract, see Yeh, Y. C. M.

S083 Overview of Novel Photovoltaic Conversion Techniques at High Intensity Levels

R. J. Stirn

Radiation Energy Conversion in Space, AIAA, New York, pp. 136-151, 1978

Photovoltaic conversion of electromagnetic energy into electrical energy has been of interest especially in space for the following reasons: (1) built-in redundancy leading to high reliability, (2) versatility in voltage and current output by use of series and parallel connections, (3) proven technology for some applications, (4) relative ruggedness, (5) absence of hazardous materials, and (6) potential conversion efficiencies of 40-45% for monochromatic energy and about 20% for space (AMO) sunlight. This report describes some novel concepts for photovoltaic devices, which under concentrated light energy may reach efficiencies of 30 to 40% for sunlight, and devices which may be tailored for specific laser wavelengths and intensities.

The use of high solar intensity levels is attractive since the total area of photovoltaic devices is reduced, and hence, the total system costs by an amount depending on the optics subsystem costs. The additional latitude in solar cell costs can allow for more sophisticated cell structure, offering higher conversion efficiency and higher cell operating temperature.

Among the solar cell structures discussed are: (1) Al-(Ga)As/GaAs solar cells designed for high light intensity, (2) multi-layer monolithic cells using ternary compounds which, by their differences in energy band gap, effectively split the solar spectrum into portions where each cell section operates most efficiently, (3) systems where the solar spectrum is split by means of optical filters with the appropriate band of wavelengths diverted to two or three separate solar cells with different, but optimum, band gap and (4) a structure which, by means of heating an incandescent radiator to about 1800°C, better utilizes the solar spectrum to potentially provide a conversion efficiency of 40 to 50% with silicon (thermophotovoltaics).

Also discussed are photovoltaic devices which are more conventional in structure, but different in usage of material. Such devices, made possible because of the development of chemical vapor deposition techniques, can be tailored to convert high energy laser radiation with efficiencies over 40% even at wavelengths well under 500 nm.

STOKES, B. O.

S084 Assessment of Free-Living Nitrogen Fixing Microorganisms for Commercial Nitrogen Fixation

B. O. Stokes and C. J. Wallace

JPL Publication 78-60, August 1, 1978

The importance of ammonia to the U S economy and the large fossil energy requirements of commercial ammonia production have focused research attention on biological systems for the production of ammonia and possibly hydrogen. Recent advances in microbial genetics suggest the possibility of adapting freeliving nitrogen-fixing microorganisms to the commercial production of fixed nitrogen.

This economic assessment indicates that ammonia production by *Klebsiella pneumoniae* is not economical with present strains and improving nitrogen fixation to its theoretical limits in this organism is not sufficient to achieve economic viability. Contamination and reversion of the mutant are major technical problems. This leads to sterilization requirements which are economically prohibitive. Ammonia is a low value product and has been obtained only in dilute solutions with biological systems. Since the value of both the hydrogen produced by this organism and the methane value of the carbon source required greatly exceed the value of the ammonia formed, ammonia (fixed nitrogen) should be considered the by-product and attention should be focused on other products. The production of hydrogen by *Klebsiella* or other anaerobic nitrogen fixers should receive additional study, since the value of hydrogen produced by *Klebsiella* greatly exceeds the value of the nitrogen fixed and since the activity of nitrogenase offers a significant improvement in hydrogen production.

At observed efficiencies, the production of fixed nitrogen in the form of cell mass by *Azotobacter* is also uneconomical and the methane value of the carbon substrate exceeds the value of the nitrogen fixed. Parametric studies indicate that as efficiencies approach the theoretical limits the economics may become competitive under the assumptions of the economic model employed. The use of *nif*-derepressed microorganisms, particularly blue-green algae, may have significant potential for *in situ* fertilization in the environment. Additional work is required to determine 1) the extent of *in situ* nitrogen fixation when *nif*-derepressed strains are added to the environment and, 2) how effective these strains are in increasing crop yields through the production of substances other than fixed nitrogen which may enhance plant growth.

Prepared for the National Science Foundation, research applied to the National Needs Program

STOLLER, F. W.

S085 Energy Consumption Program—A Computer Model Simulating Energy Loads in Buildings

F. W. Stoller, F. L. Lansing, V. W. Chai, and S. Higgins

The Deep Space Network Progress Report 42-45
March and April 1978, pp 288-293, June 15, 1978

The JPL Energy Consumption Computer Program has been primarily developed as a useful tool in the on-going building modification studies in the DSN energy conservation project. The program simulates building heating and cooling loads and computes thermal and electric energy consumption and cost. It is a very low-cost code compared with other sophisticated programs such as NECAP (costs 1/200 of NECAP) or with other commercial ones such as ECUBE, TRACE, etc. The accuracy of computations are not sacrificed, however, since the results lie within $\pm 10\%$ margin compared to those read from energy meters. The program is carefully structured to reduce both user's time and running cost by asking minimum information from the user and reducing many internal time-consuming computational loops. Many unique features were added to handle two-level electronics control rooms not found in any other program.

STRAND, L. D.

S086 Nitramine Smokeless Propellant Research—Annual Research Progress Report

N. S. Cohen and L. D. Strand

JPL Publication 78-6, November 1977

For abstract, see Cohen, N. S.

STROMBERG, W.

S087 Application of Multispectral Radar and LANDSAT Imagery to Geologic Mapping in Death Valley

M. Daily, C. Elachi, T. Farr, W. Stromberg, S. Williams, and G. Schaber (U. S. Geological Survey)

JPL Publication 78-19, March 30, 1978

For abstract, see Daily, M.

STROMBERG, W. D.

S088 Computer Processing of SAR L-Band Imagery

M. L. Bryan, W. D. Stromberg, and T. G. Farr

Photogram Eng Remote Sensing, Vol 43, No 10, pp 1283-1294, October 1977

For abstract, see Bryan, M. L.

STUART, J. R.

S089 System Design of an Ion Drive Spacecraft

J. R. Stuart

Preprint 78-642, AIAA/DGLR Thirteenth Int Electric Propulsion Conf, San Diego, Calif, April 25-27, 1978

As electric propulsion technology has improved and mission requirements have changed, a series of Ion Propulsion Module (IPM) design concepts have evolved. The most recent iteration occurred in the NASA-sponsored Halley Comet Rendezvous Mission (HCRM) study of ion drive. The synthesis of an interplanetary spacecraft design using an IPM as the primary propulsion source poses significant system design challenges. The object of this paper is to describe the spacecraft system design considerations introduced by the integration of such an IPM as the primary propulsion source. In particular, the synthesis of the HCRM spacecraft design is described and spacecraft system design considerations for other interplanetary applications are discussed. IPM interactions with the system (especially telecommunications and science) are found to be manageable. The spacecraft design developed for the HCRM indicates the interface simplicity between the IPM and spacecraft. Methods are shown for readily applying this IPM to a variety of planetary missions. Methods are also described for the IPM to provide up to 5 kW to the spacecraft for increasing the mission science return.

S090 New Concepts for Mercury Orbiter Missions

J. R. French, J. R. Stuart, and B. Zeldin

Preprint 78-79, AIAA Sixteenth Aerospace Sciences Meeting, Huntsville, Ala, January 16-18, 1978

For abstract, see French, J. R.

SUMIDA, J. T.

S091 A Bandwidth Compressive Modulation System Using Multi-Amplitude Minimum Shift Keying (MAMSK)

W. J. Weber III, P. H. Stanton, and J. T. Sumida

IEEE Trans Commun, Vol COM-26, No 5, pp 543-551, May 1978

For abstract, see Weber, W. J. III

SWEETNAM, D.

S092 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle, E. Christensen, D. Farless, J. Mehta, B. Seidel, W. Michael, Jr. (Langley Research Center), A. Wallio (Langley Research Center), and M. Grossi (Raytheon Company)

J Geophys Res, Vol 82, No 28, pp 4317-4324, September 30, 1977

For abstract, see Fjeldbo, G.

TANAKA, H.

T001 Electron-Impact Excitation of the Low-Lying Electronic States of HCN

A. Chutjian, H. Tanaka, B. G. Wicke (TRW Systems Group), and S. K. Srivastava

J Chem Phys, Vol 67, No 11, pp 4835-4839, December 1977

For abstract, see Chutjian, A.

T002 Elastic Scattering of Intermediate Energy Electrons by HCN

S. K. Srivastava, H. Tanaka, and A. Chutjian

J Chem Phys, Vol 69, No 4, pp 1493-1497, August 15, 1978

For abstract, see Srivastava, S. K.

TAUSWORTHE, R. C.

T003 Standardized Development of Computer Software-Part II. Standards

R. C. Tausworthe

Special Publication 43-29, Part II, August 1978

This monograph is an extension of the methodology of part I and contains standards for software development and engineering. The book sets forth rules for design, specification, coding, testing, documentation, and quality assurance audits of software; it also contains detailed outlines for the documentation to be produced.

T004 The DSN Standard Real-Time Language

R. L. Schwartz, G. L. Fisher, and R. C. Tausworthe

The Deep Space Network Progress Report 42-44 January and February 1978, pp 131-138, April 15, 1978

For abstract, see Schwartz, R. L.

TAYLOR, F. H. J.

- T005 Deep Space Network to Viking Orbiter Telecommunications Performance During the Viking Extended Mission, November 1976 Through February 1978**

F. H. J. Taylor

The Deep Space Network Progress Report 42-45 March and April 1978, pp 7-34, June 15, 1978

This article discusses the telecommunications performance during the Viking extended mission, starting with the completion of the first superior conjunction in November 1976 and ending with the jettison of the VO-2 aft bioshield early in March 1978. Continued Viking operations are planned through February 1979, concluding with the second superior conjunction. Included in this article are Viking Orbiter activities and problems, the ground system activities and problems, radio science activities, and communication link performance. The substantial involvement of the Deep Space Network and the coordination of their telecommunications planners with Viking Project telecommunications analysts in the planning and execution of complex Viking Orbiter sequences are discussed.

TAYLOR, F. W.

- T006 The D/H and C/H Ratios in Jupiter From the CH₃D Phase**

R. Beer and F. W. Taylor

Astrophys J, Vol 219, No 2, Part 1, pp 763-767, January 15, 1978

For abstract, see Beer, R.

- T007 Venus Cloud Structure and Water Vapor Abundance From Mariner 10 Observations**

F. W. Taylor

Space Research XVI, pp 969-973, Akademie-Verlag, Berlin, 1976

Observations of the Venus atmosphere with the infrared radiometer on Mariner 10 have been analyzed by Taylor in terms of the vertical distribution of opacity at wavelengths near 11 μm and 45 μm in the thermal infrared. In this paper, we discuss models of the Venus atmosphere which are consistent with the inferred opacity structure. Either a two-layer cloud structure, or a single cloud deck overlaid by a layer containing approximately 40 precipitable μm of water vapor, would have the required limb-darkening characteristics at the wavelengths of observation.

TAYLOR, H.

- T008 FPLA Mechanization of Arithmetic Elements to Produce A + B or to Pass A Only**

D. E. Wallis, H. Taylor, and A. L. Rubin

The Deep Space Network Progress Report 42-46 May and June 1978, pp 76-80, August 15, 1978

For abstract, see Wallis, D. E.

TAYLOR, T. M.

- T009 DSN "Load and Go" Pre-Track Preparation for Voyager Support**

T. M. Taylor

The Deep Space Network Progress Report 42-45 March and April 1978, pp 302-305, June 15, 1978

The use of Level 4 Prepass Readiness Tests ("load and go" pre-track preparation) provides an efficient increase in Network productivity. Application of this method of operation was evaluated for Voyager support, so that increased tracking could be provided to all projects during a period of continued interproject conflicts.

TERRANOVA, T.

- T010 Synthesis and Biological Screening of Novel Hybrid Fluorocarbon Hydrocarbon Compounds for Use as Artificial Blood Substitutes—Annual Report, July 1976–July 1977**

J. Moacanin, K. Scherer, A. Toronto (Utah Biological Test Laboratory), D. Lawson, T. Terranova, L. Astle (Utah Biological Test Laboratory), and S. Harvey (Utah Biological Test Laboratory)

JPL Publication 77-80, January 15, 1978

For abstract, see Moacanin, J.

THEARD, L. P.

- T011 Variable Fragmentation Mass Spectrometry Using Chemi-ionization**

J. B. Laudenslager and L. P. Theard

Advances in Mass Spectrometry Proc Seventh Int Mass Spectrometry Conf, Florence, Italy, August 30–September 3, 1976, Vol 7B, pp 1388-1393

For abstract, see Laudenslager, J. B.

THOMAS, J. B.

T012 The Tone Generator and Phase Calibration in VLBI Measurements

J. B. Thomas

The Deep Space Network Progress Report 42-44 January and February 1978, pp 63-74, April 15, 1978

In very long baseline interferometry (VLBI) applications, the measurements of geophysical/astrometric quantities and clock synchronization are degraded by unknown and unstable phase effects due to instrumentation. Most of these phase effects can be removed through the use of a tone generator that injects near the front of the instrumentation a set of tones derived from the station frequency standard. When properly used, such a calibration technique will not only remove post-injection instrumental phase instabilities, but will also allow absolute calibration of interferometer phase so that clock synchronization is possible. As implied, these advantages of the tone generator pertain only to instrumental effects after the injection point. This report presents a nonrelativistic mathematical model to describe the calibration signal, its processing, and its use in removing instrumental effects from interferometer phase.

THOMAS, P.

T013 The Puzzling Moons of Mars

J. Veverka (Cornell University), P. Thomas (Cornell University), and T. Duxbury

Sky Telesc, Vol. 56, pp 186-189, September 1978

For abstract, see Veverka, J

THOMPSON, T. W.

T014 Detection and Interpretation of Ocean Roughness Variations Across the Gulf Stream Inferred From Radar Cross Section Observations

D. E. Weissman and T. W. Thompson

Oceans '77 Conference Record, pp 14B-1-14B-10, IEEE, New York, N Y and The Marine Technology Society, Washington, D C, 1977

For abstract, see Weissman, D E

THORMAN, H. C.

T015 DSN Test and Training System, Mark III-77

H. C. Thorman

The Deep Space Network Progress Report 42-44 January and February 1978, pp 4-15, April 15, 1978

Implementation of the DSN Test and Training System, Mark III-77, throughout the network is nearing completion. The Mark III-77 system is configured to support DSN testing and training for the Pioneer-Venus 1978 mission and all on-going, in-flight missions. DSN Test and Training System capabilities include functions performed in the Deep Space Stations, Ground Communications Facility, and Network Operations Control Center.

THORNTON, C. L.

T016 Linear Stochastic Control Using the UDU^T Matrix Factorization

C. L. Thornton and R. A. Jacobson

J Guidance Contr, Vol 1, No 4, pp 232-236, July-August 1978

The classical LQG stochastic control law is reformulated using the matrix factorization $S = UDU^T$. This method yields a statistical guidance analysis algorithm that is numerically superior to the classical solution yet requires negligible additional computation and storage. Moreover, experience with $U-D$ algorithms has shown them to be adaptable and easy to implement on a variety of problems.

T017 Elements of Solar Sail Navigation With Application to a Halley's Comet Rendezvous

R. A. Jacobson and C. L. Thornton

J Guidance Contr, Vol 1, No 5, pp 365-371, September-October 1978

For abstract, see Jacobson, R. A.

T018 Statistical Error Analysis Using the UDU^T Covariance Factorization

C. L. Thornton and D. M. Wiberg (University of California, Los Angeles)

Proc IEEE Conf Decision and Control, New Orleans, La, Dec 7-9, 1977, Vol 1, pp 19-28

A numerically improved covariance error analysis algorithm is derived using the matrix factorization $P = UDU^T$. The algorithm employs computationally sound transformation techniques to ensure increased precision and stability. The advantages of this approach are demonstrated by applying the $U-D$ and conventional evaluation algorithms to a representative orbit determination problem. Throughout the comparison study the conventional covariance method continually experiences serious accuracy degradations and often produces useless or in-

consistent results The U-D algorithm, on the other hand, demonstrates its inherent stability by consistently matching the extended precision reference results Moreover, the U-D method is found to be efficient and easy to implement, requiring no more storage or computation than the conventional covariance algorithm

THORPE, T. E.

T019 Inflight Performance of the Viking Visual Imaging Subsystem

K. P. Klaasen, T. E. Thorpe, and L. A. Morabito

Appl Opt, Vol 16, pp 3158-3170,
December 1977

For abstract, see Klaasen, K P

T020 Viking Orbiter Observations of Atmospheric Opacity During July–November 1976

T. E. Thorpe

J Geophys Res, Vol. 82, No 28, pp 4151–4159,
September 30, 1977

Viking orbiter photography during the primary mission combined with lander indications of surface properties have permitted the estimation of atmospheric optical depths and phase functions. Highly variable time of day opacities ranging from 0.05 to 0.6 are seen to occur in three principal regions A wavelength-dependent particulate component plus a time variable grey aerosol of higher density may explain these opacities versus time of day These data should serve as a basis for extended mission comparisons

T021 Viking Orbiter Photometric Observations of the Mars Phase Function July Through November 1976

T. E. Thorpe

J Geophys Res, Vol 82, No 28, pp 4161–4165,
September 30, 1977

Over 7200 Viking Orbiter pictures have provided phase function information over a large range in viewing geometry. Comparison with the earlier Mariner 9 data reveals possibly significant changes A two-component limb darkening characterization is shown to fit the data better at large phase angles than the traditional Minnaert or Lommel-Seeliger approach The phase integral is 15% larger than the Mariner 9 observations owing in part to data obtained at larger phase angles revealing apparent condensate phenomena

TOLSON, R. H.

T022 Viking First Encounter of Phobos: Preliminary Results

R. H. Tolson, et al.

Science, Vol 199, pp 61–64, January 6, 1978

During the last 2 weeks of February 1977, an intensive scientific investigation of the martian satellite Phobos was conducted by the Viking Orbiter-1 (VO-1) spacecraft More than 125 television pictures were obtained during this period and infrared observations were made About 80 percent of the illuminated hemisphere was imaged at a resolution of about 30 meters Higher resolution images of limited areas were also obtained Flyby distances within 80 kilometers of the surface were achieved An estimate of the mass of Phobos (GM) was obtained by observing the effect of Phobos's gravity on the orbit of VO-1 as sensed by Earth-based radiometric tracking Preliminary results indicate a value of GM of 0.00066 ± 0.00012 cubic kilometer per second squared (standard deviation of 3) and a mean density of about 1.9 ± 0.6 gram per cubic centimeter (standard deviation of 3) This low density, together with the low albedo and the recently determined spectral reflectance, suggest that Phobos is compositionally similar to type I carbonaceous chondrites Thus, either this object formed in the outer part of the asteroid belt or Lewis's theory that such material cannot condense at 1.5 astronomical units is incorrect. The data on Phobos obtained during this first encounter period are comparable in quantity to all of the data on Mars returned by Mariner flights 4, 6, and 7.

Contributors to this article include:

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Cornell University J. Veverka

California Institute of Technology G. Neugebauer

Analytic Mechanics Associates, Inc J. T. Findlay

TORONTO, A.

T023 Synthesis and Biological Screening of Novel Hybrid Fluorocarbon Hydrocarbon Compounds for Use as Artificial Blood Substitutes—Annual Report, July 1976–July 1977

J. Moacanin, K. Scherer, A. Toronto (Utah Biological Test Laboratory), D. Lawson, T. Terranova, L. Astle (Utah Biological Test Laboratory), and S. Harvey (Utah Biological Test Laboratory)

TRAJMAR, S.

T024 Electron Scattering by Metal Vapors

S Trajmar

Electronic and Atomic Collisions Tenth Int Conf Phys of Electron and At Collisions, Paris, France, July 21-27, 1977, pp 113-128

Electron scattering measurements at low and intermediate impact energies (from near threshold to few hundred eV) carried out in our laboratory are summarized. Differential and integral cross sections for elastic and inelastic scattering and for momentum transfer have been determined and the ionization and autoionization processes associated with intermediate shell and multi-electron excitation processes have been studied. Specific examples for Li, K, Mg, Ba, Cu, Zn, Mn, Pb, Bi, and Tl are presented. Electron scattering from laser excited Ba states has also been investigated and a large number of superelastic and excited state to excited state transitions have been observed. The measurement of the cross sections and their relationship to the alignment and orientation tensors are discussed.

T025 Cross Sections for Electron Impact Excitation of the Electronic States of N_2

D. C. Cartwright (Los Alamos Scientific Laboratory), S. Trajmar, and A. Chutjian

Electronic and Atomic Collisions Tenth Int Conf on the Phys of Electron and At Collisions, Paris, France, July 21-27, 1977, pp 128-129

For abstract, see Cartwright, D. C.

T026 Electron Scattering by Highly Polar Molecules II. LiF

L. Vuskovic (Institute of Physics, Beograd, Yugoslavia), S. K. Srivastava, and S. Trajmar

J Phys B At Molec Phys, Vol 11, No 9, pp 1643-1652, 1978

For abstract, see Vuskovic, L.

T027 Electron-Impact Cross Sections for Cu Atoms

S. Trajmar, W. Williams, and S. K. Srivastava

J Phys B At Mol Phys, Vol 10, No 16, 3323-3333, 1977

Relative differential electron-impact cross sections have been measured for elastic scattering for excitation of the $3d^{10}4p^2P_{1/2,3/2}$, $3d^94s^2^2D_{5/2}$ and $3d^94s^2^2D_{3/2}$ states of

Cu at 6, 10, 20, 60 and 100 eV in the 0° to 140° angular range. The relative values were normalized to the absolute scale by utilizing He as a secondary standard for determining the correct energy dependence and by accepting the value of the calculated elastic differential cross section at 100 eV, 40° as $1.28 \times 10^{-16} \text{ cm}^2 \text{ sr}^{-1}$. Integral and momentum-transfer cross sections have been obtained by extrapolation to 180° . The cross section for the excitation of the $2P$ state is large compared to that for elastic scattering, and population inversion in this state with respect to the $2D$ state is readily achieved by electron impact. None of the theoretical predictions utilizing classical, Born or static-exchange approximations agree with the experimental results at low impact energies.

T028 Electron Impact Excitation of Magnesium at 10, 20 and 40 eV Impact Energies

W. Williams and S. Trajmar

J Phys B At Mol Phys, Vol 11, No 11, pp 2021-2029, 1978

For abstract, see Williams, W.

T029 Elastic and Inelastic Scattering of Electrons by Atomic Manganese

W. Williams, J. C. Cheeseborough III (Claremont Men's College), and S. Trajmar

J Phys B At Mol Phys, Vol 11, No 11, pp 2031-2036, 1978

For abstract, see Williams, W.

TRUBERT, M. R.

T030 A Highly Accurate Method for the Determination of Mass and Center of Mass of a Spacecraft

E. Y. Chow, A. Egwuatu, and M. R. Trubert

JPL Publication 78-2, April 15, 1978

For abstract, see Chow, E. Y.

TRUONG, T. K.

T031 A Fast DFT Algorithm Using Complex Integer Transforms

I. S. Reed and T. K. Truong

The Deep Space Network Progress Report 42-43 November and December 1977, pp 134-140, February 15, 1978

For abstract, see Reed, I. S.

T032 Transform Decoding of Reed-Solomon Codes Over $GF(2^n)$ Using the Techniques of Winograd

I. S. Reed (University of Southern California),
T. K. Truong, and B. Benjauthrit

The Deep Space Network Progress Report 42-43
November and December 1977, pp 141-163,
February 15, 1978

For abstract, see Reed, I S

T033 On Decoding of Reed-Solomon Codes Over $GF(32)$ and $GF(64)$ Using the Transform Techniques of Winograd

I. S. Reed (University of Southern California),
T. K. Truong, and B. Benjauthrit

The Deep Space Network Progress Report 42-44
January and February 1978, pp 139-171,
April 15, 1978

For abstract, see Reed, I S

T034 A New Hybrid Algorithm for Computing a Fast Discrete Fourier Transform

I. S. Reed (University of Southern California) and
T. K. Truong

The Deep Space Network Progress Report 42-45
March and April 1978, pp 172-185, June 15,
1978

For abstract, see Reed, I S

T035 A New Algorithm for Computing Primitive Elements in $GF(q^2)$

I. S. Reed (University of Southern California),
T. K. Truong, and R. L. Miller

The Deep Space Network Progress Report 42-45
March and April 1978, pp 190-196, June 15,
1978

For abstract, see Reed, I S

T036 A Fast Computation of Complex Convolution Using a Hybrid Transform

I. S. Reed (University of Southern California) and
T. K. Truong

The Deep Space Network Progress Report 42-46
May and June 1978, pp 92-99, August 15, 1978

For abstract, see Reed, I S

T037 A Simplified Algorithm for Correcting Both Errors and Erasures of R-S Codes

I. S. Reed (University of Southern California) and
T. K. Truong

The Deep Space Network Progress Report 42-48
September and October 1978, pp 66-71,
December 15, 1978

For abstract, see Reed, I S

TRUSCELLO, V. C.

T038 Proceedings of the Alternate Energy Systems Seminar

M. E. Alper, R. E. Bartera, H. S. Davis,
R. G. Forney, C. F. Mohl, H. J. Stewart, and
V. C. Truscello

JPL Publication 78-45, March 30, 1978

For abstract, see Alper, M E

TSURUTANI, B. T.

T039 Observations of the Interplanetary Sector Structure up to Heliographic Latitudes of 16° Pioneer 11

E. J. Smith, B. T. Tsurutani, and
R. L. Rosenberg (University of California, Los
Angeles)

J Geophys Res, Vol 83, No A2, pp 717-724,
February 1, 1978

For abstract, see Smith, E J

TUCKER, R.

T040 Processing the Viking Lander Camera Data

E. C. Levinthal (Stanford University), W. Green,
K. L. Jones (Brown University), and
R. Tucker (Stanford University)

J Geophys Res, Vol 82, No 28, pp 4412-4420
September 30, 1977

For abstract, see Levinthal, E C

TUREGANO, J. A.

T041 Evidence of an Increase in the Microwave Brightness Temperature of Uranus

M. J. Klein and J. A. Turegano

Astrophys J, Vol 224, pp L31-L34, August 15,
1978

For abstract, see Klein, M J

TURNER, G. B.

T042 Structure of Deformed Silicon and Implications for Low Cost Solar Cells

N. Mardesich, M. H. Leipold, G. B. Turner, and T. G. Digges, Jr.

JPL Publication 78-13, March 1, 1978

For abstract, see Mardesich, N

UDLOCK, D. E.

U001 Storage of Solid Propellants in a Dry Environment

D. E. Udlock

JPL Publication 78-99, November 15, 1978

Storage of solid propellants in either a dry or a vacuum environment causes a significantly greater increase in the propellants' modulus and maximum tensile strength than does ambient storage. It is postulated that these physical property changes can be attributed to the effect trace amounts of moisture has on the bond between the propellants' binder and oxidizer.

UPHOFF, C.

U002 Planetary Benchmarks

C. Uphoff, R. Staehle, M. Kobrick, R. Jurgens, H. Price, M. Slade, and D. Sonnabend

JPL Publication 78-94, December 1, 1978

This report is a description of a study conducted during the summer of 1978 aimed at the establishment of design criteria and technology requirements for a system of radar reference devices to be fixed to the surfaces of the inner planets. Primary emphasis has been placed upon study of passive radar retroreflectors for the harsh environment on the surface of Venus. Science rationale includes measurement of the motion of Venus' pole, ephemeral improvement, cartographic reference points for precision mapping, and the possibility of measurement of large crustal motion if it exists.

Also discussed are some interesting offshoot applications including the use of radar corner reflectors as landing beacons on the planetary surfaces and some deep space applications that may yield a greatly enhanced knowledge of the gravitational and electromagnetic structure of the solar system.

It is shown that passive retroreflectors with dimensions of about 4 meters and weighing about 10 kg are feasible for use with orbiting radar at Venus and Mars. Earth-based observation of passive reflectors, however, would require very large and complex structures to be delivered to the surfaces. For Earth-based measurements, it is

concluded that surface transponders offer a distinct advantage in accuracy over passive reflectors. A conceptual design for a high temperature transponder is presented. The design appears feasible for the Venus surface using existing electronics and power components.

URBENAJO, R

U003 JPL Energy Consumption Program (ECP) Documentation: A Computer Model Simulating Heating, Cooling and Energy Loads in Buildings

F. L. Lansing, V. W. Chai, S. N. Higgins, D. Lascu, R. Urbanajo, and P. Wong

JPL Publication 78-76, September 15, 1978

For abstract, see Lansing, F. L.

URECH, J. M.

U004 S-Band Maser Phase Delay Stability Tests

J. M. Urech, F. Alcazar, J. Galvez, A. Rius, and C. A. Greenhall

The Deep Space Network Progress Report 42-48
September and October 1978, pp 102-117,
December 15, 1978

This article summarizes the results of the S-band traveling-wave maser phase delay stability measurements performed at DSS 62. These tests were required for the Pioneer-Venus wind experiment.

VAIRIN, D. L.

V001 Analysis of DOT Near-Term Transportation Research, Development, and Demonstration Activities

L. E. Baker, D. W. Humphreys, and D. L. Vairin

JPL Publication 78-49, May 15, 1978

For abstract, see Baker, L. E.

VAISNYS, J. R.

V002 Formation of Metallic LiH

J. R. Vaisnys (Yale University) and J. S. Zmuidzinas

Appl Phys Lett, Vol 32, No 3, pp 152-153,
February 1, 1978

It is shown that a metallic form of LiH may be produced at the relatively low transition pressure of 1.1 mbar. LiH may thus be applied to studies of insulator-metal transition at high pressure. Experimental data is used to calcu-

late LiH transition parameters first, Herzfeld's criterion is used to determine the volume at which metallic behavior begins, and, second, pressure-volume measurements for estimating the pressure at which this volume is achieved are extrapolated. For comparison, the same volume-pressure calculation is performed for H_2 , and it is found that the metallization of LiH should occur more easily than that of H_2 .

VAN AMERSFOORT, J.

V003 The ISEE-C Vector Helium Magnetometer

A. M. A. Frandsen, B. V. Connor,
J. Van Amersfoort, and E. J. Smith

IEEE Trans Geosci Electron, Vol GE-16, No 3,
pp 195-198, July 1978

For abstract, see Frandsen, A. M. A.

VAN HOLLEBEKE, M. A. I.

V004 The Energetic Particle Environment of the Solar Probe Mission—As Estimated by the Participants in the Solar Probe Environment Workshop

M. Neugebauer, L. A. Fisk, R. E. Gold, R. P. Lin,
G. Newkirk, J. A. Simpson, and
M. A. I. Van Hollebeke

JPL Publication 78-64, September 1, 1978

For abstract, see Neugebauer, M.

VAN TILBORG, H.

V005 An Analysis of Alternate Symbol Inversion for Improved Symbol Synchronization in Convolutionally Coded Systems

L. D. Baumert, R. J. McEliece, and
H. van Tilborg (Technological University,
Netherlands)

The Deep Space Network Progress Report 42-44
January and February 1978, pp 90-97, April 15,
1978

For abstract, see Baumert, L. D.

VAN TILBORG, H. C. A.

V006 On the Inherent Intractability of Certain Coding Problems

E. R. Berlekamp (University of California,
Berkeley), R. J. McEliece, and
H. C. A. van Tilborg (Technological University of
Eindhoven, Netherlands)

IEEE Trans Inform Theor, Vol IT-24, No 3, pp
384-386, May 1978

For abstract, see Berlekamp, E. R.

VEEDER, G. J.

V007 Visual and Infrared Photometry of Asteroids

G. J. Veeder, D. L. Matson, and J. C. Smith

Astron J, Vol 83, No 6, pp 651-663,
June 1978

We report the results of a survey of asteroids at 0.56, 1.6 and 2.2 μ . The observations of thirty asteroids are reduced to relative reflectances R_v at 1.6 μ and 2.2 μ (such that $R_v(0.56 \mu)$ is scaled to unity). These relative reflectances have important implications for the classification of asteroids. Low albedo asteroids show a significant range in their infrared relative reflectances, but carbonaceous chondritic-type material remains a good candidate for their surface composition. Many S-type asteroids are found to have significantly brighter infrared relative reflectances than M-type asteroids. Lunar-like, dark glass on the surfaces of these objects is probably ruled out. A metallic phase is the most plausible candidate which implies a multiple component surface composition perhaps similar to certain stony-iron meteorites. Our data suggest that such a metallic phase may be common in the inner asteroid belt.

V008 Asteroids and Comparative Planetology

D. L. Matson, F. P. Fanale, T. V. Johnson, and
G. J. Veeder

Proc Seventh Lunar Sci Conf, Houston, Tex,
March 15-19, 1976, pp 3603-3627

For abstract, see Matson, D. L.

VEEDER, G. V.

V009 Soil Maturity and Planetary Regoliths: The Moon, Mercury, and the Asteroids

D. L. Matson, T. V. Johnson, and G. V. Veeder

Proc Eighth Lunar Sci Conf, Houston, Tex, March
14-18, 1977, pp 1001-1011

For abstract, see Matson, D. L.

VETTER, A. A.

V010 Effect of Dissociation Pulse Circuit Inductance on the CuCl Laser

A. A. Vetter (California Institute of Technology)
and N. M. Nerheim

IEEE J Quantum Electron, Vol QE-14, No 2, pp 73-74, February 1978

The performance of the double-pulsed CuCl laser is improved by a decrease in the inductance of the dissociation pulse circuit. Higher efficiency is obtained due to a larger ground state copper atom population and lower optimum dissociation energy.

V011 Scaling a Double-Pulsed Copper Chloride Laser to 10 mJ

N. M. Nerheim, A. A. Vetter (California Institute of Technology), and G. R. Russell

J Appl Phys, Vol. 49, No. 1, pp 12-15, January 1978

For abstract, see Nerheim, N M

VEVERKA, J.

V012 Viking Imaging of Phobos and Deimos: An Overview of the Primary Mission

T. C. Duxbury and J. Veverka (Cornell University)

J. Geophys Res, Vol 82, No 28, pp. 4203-4211, September 30, 1977

For abstract, see Duxbury, T C

V013 Viking Observations of Phobos and Deimos: Preliminary Results

J. Veverka (Cornell University) and T. C. Duxbury

J Geophys Res, Vol. 82, No. 28, pp 4213-4223, September 30, 1977

The improved resolution of the Viking orbiter images has led to the discovery of a number of unusual features on the surface of Phobos: (1) elongated rill-like depressions associated with the crater Stickney (possibly surface fractures), (2) chains of irregular craters which sometimes show a "herringbone" pattern (possibly secondaries), and (3) sets of almost parallel linear striations of uncertain origin. The crater chains are not randomly oriented but tend to lie parallel to the orbital plane of Phobos. The striations, on the other hand, appear to form arcs of small circles which are normal to the Mars-Phobos direction. With the possible exception of feature (2), similar features have not been recognized on Deimos, possibly because of the coarser resolution of available imagery. The Viking data demonstrate that the surfaces of both satellites are definitely saturated with craters ≥ 300 m across.

V014 The Composition of Phobos: Evidence for Carbonaceous Chondrite Surface From Spectral Analysis

K. D. Pang (Planetary Science Institute), J. B. Pollack (Ames Research Center), J. Veverka (Cornell University), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp. 64-66, January 6, 1978

For abstract, see Pang, K D

V015 Multicolor Observations of Phobos With the Viking Lander Cameras: Evidence for a Carbonaceous Chondritic Composition

J. B. Pollack (Ames Research Center), J. Veverka (Cornell University), K. Pang (Planetary Science Institute), D. Colburn (Ames Research Center), A. L. Lane, and J. M. Ajello

Science, Vol 199, pp. 66-69, January 6, 1978

For abstract, see Pollack, J B

V016 Deimos Encounter by Viking: Preliminary Imaging Results

T. C. Duxbury and J. Veverka (Cornell University)

Science, Vol 201, pp 812-814, September 1, 1978

For abstract, see Duxbury, T C

V017 The Puzzling Moons of Mars

J. Veverka (Cornell University), P. Thomas (Cornell University), and T. Duxbury

Sky Telesc, Vol. 56, pp 186-189, September 1978

Viking Orbiter observations of Phobos and Deimos are presented with attention to physical dimension and surface features. Both satellites are approximately 1.4 times as long as they are wide, Phobos having a length of 27 km, while Deimos is half that size. In addition, both satellites are tidally locked, as is Earth's moon, and are held together by cohesive forces as well as by gravity. Phobos and Deimos are both heavily cratered, and Phobos has deep (30 m) grooves in the vicinity of its largest crater, Stickney, indicating surface fracturing under meteorite impact. The craters on Deimos are largely filled with a fine-grained substance, probably crater ejecta.

VIVIAN, H. C.

V018 Automated Mixed Traffic Vehicle (AMTV) Technology and Safety Study

A. R. Johnston, T. K. C. Peng, H. C. Vivian, and P. K. Wang

JPL Publication 78-12, February 1978

For abstract, see Johnston, A. R.

VOLKSEN, W.

V019 Labeled Cells

A Rembaum, S. P. S. Yen, and
W. Volksen (IBM)

CHEMTECH, Vol 8, pp 182-190, March 1978

For abstract, see Rembaum, A

V020 Photoacoustic Spectroscopy of Organometallic Compounds With Applications in the Fields of Quasi-One-Dimensional Conductors and Catalysis

R. B. Somoano, A. Gupta, W. Volksen,
A. Rembaum, and R. Williams (California Institute
of Technology)

Organometallic Polymers, pp 165-174, Academic
Press, Inc., New York, N Y, 1978

For abstract, see Somoano, R. B

VON ROOS, O.

V021 Determination of Bulk Diffusion Lengths for Angle-lapped Semiconductor Material via the Scanning Electron Microscope—A Theoretical Analysis

O. von Roos

JPL Publication 78-47, May 31, 1978

A standard procedure for the determination of the minority carrier diffusion length by means of a scanning electron microscope (SEM) consists in scanning across an angle-lapped surface of a P-N junction and measuring the resultant short circuit current I_{sc} as a function of beam position. A detailed analysis of the I_{sc} originating from this configuration is presented. It is found that, for a point source excitation, the I_{sc} depends very simply on x , the variable distance between the surface and the junction edge. The expression for the I_{sc} of a planar junction device is well known. If d , the constant distance between the plane of the surface of the semiconductor and the junction edge in the expression for the I_{sc} of a planar junction is merely replaced by x , the variable distance of the corresponding angle-lapped junction, an expression results which is correct to within a small fraction of a percent as long as the angle between the surfaces, $2\theta_1$, is smaller than 10° .

Prepared for the Department of Energy, DOE/JPL-1012-78/8, Distribution Category UC-636

V022 A Note on the Assumption of Quasiequilibrium in Semiconductor Junction Devices

O von Roos

J Appl Phys, Vol 48, No 12, pp 5389-5391,
December 1977

The usual junction relations connecting the number densities of minority and majority carriers across the junction or depletion layer of a p - n junction are *only* applicable to conditions pertaining to low-level injection. Although this fact has been suspected to be true for a long time, the general consensus has been that only exact numerical calculations will reveal at which injection level the simple junction relations become incorrect. Here we wish to point out that simple algebraic manipulations of the quasiequilibrium equations valid at very low injection levels suffice to show at what injection level the quasiequilibrium theory becomes untenable under a given circumstance. Thus, a new and simple method is provided to ascertain if an extensive numerical calculation is warranted in order to obtain meaningful device characteristics.

V023 A Simple Theory of Back Surface Field (BSF) Solar Cells

O von Roos

J Appl Phys, Vol 49, No 6, pp 3503-3511,
June 1978

A theory of an n - p - p^+ junction is developed, entirely based on Shockley's depletion layer approximation. Under the further assumption of uniform doping the electrical characteristics of solar cells as a function of all relevant parameters (cell thickness, diffusion lengths, etc) can quickly be ascertained with a minimum of computer time. Two effects contribute to the superior performance of a BSF cell (n - p - p^+ junction) as compared to an ordinary solar cell (n - p junction). The sharing of the applied voltage among the two junctions (the n - p and the p - p^+ junction) *decreases* the dark current and the reflection of minority carriers by the built-in electric field of the p - p^+ junction *increases* the short-circuit current. The theory predicts an increase in the open-circuit voltage (V_{OC}) with a decrease in cell thickness. Although the short-circuit current decreases at the same time, the efficiency of the cell is virtually unaltered in going from a thickness of $200\ \mu\text{m}$ to a thickness of $50\ \mu\text{m}$. The importance of this fact for space missions where large power-to-weight ratios are required is obvious.

V024 Quantum Statistical Theory of Semiconductor Junctions in Thermal Equilibrium

O von Roos

Phys Rev, Pt B Solid State, Vol 16, No 12, pp
5405-5414, December 15, 1977

By means of a quantum-mechanical phase-space distribution function and its corresponding Boltzmann equation, the free-carrier and electric-field distributions of one-

dimensional semiconductor junctions (n - p , p - p^+ , etc.) are evaluated. It is shown that quantum and exchange corrections, which have been neglected in the past, play an important role in the determination of the built-in electric field within the transition region, the region in which the doping concentration changes rapidly (from n -type to p -type material for instance). This is particularly true in cases of high doping concentrations, i.e., when carrier densities become degenerate. Exact expressions will be given for the maximum built-in electric field in case of abrupt junctions. It is also shown that the exchange effect induces a slight change in the position of the band edges which persists through the homogeneous (neutral) part of the junction far away from the transition region. A numerical example is given and the quantitative differences between heavily doped (degenerate) and nondegenerate (classical) junction characteristics (maximum electric field, built-in voltage and carrier concentration within the transition region) are determined. The theory is briefly generalized to encompass high-low junctions.

V025 Recombination-Generation Currents in Degenerate Semiconductors

O von Roos

Solid-State Electron, Vol 21, pp 633-636, 1978

The classical Shockley-Read-Hall theory of free carrier recombination and generation via traps is extended to degenerate semiconductors. A concise and simple expression is found which avoids completely the concept of a Fermi level, a concept which is alien to non-equilibrium situations. Assumptions made in deriving the recombination generation current are carefully delineated and are found to be basically identical to those made in the original theory applicable to nondegenerate semiconductors.

V026 Analysis of the Interaction of an Electron Beam With a Solar Cell—I

O von Roos

Solid-State Electron, Vol 21, pp 1063-1067, 1978

When the electron beam of a scanning electron microscope (SEM) impinges on an N - P junction, the generation of electron hole pairs by impact ionization causes a characteristic short circuit current I_{SC} to flow. The I_{SC} depends strongly on the configuration used to investigate the cell's response. In this paper we consider a configuration already treated in the literature. It is the case in which the highly collimated electron beam strikes the edge of a planar junction a variable distance away from the edge of the depletion layer. The earlier treatment will be generalized to encompass the ohmic contact at the back surface. The analysis shows that a determination of the bulk diffusion length of a solar cell by means of a

SEM is impractical if the SEM is used in the configuration analyzed here.

V027 Analysis of the Interaction of an Electron Beam With a Solar Cell—II

O von Roos

Solid-State Electron, Vol 21, pp 1069-1077, 1978

In continuation of previous work, the short circuit current I_{SC} generated by a collimated electron beam impinging on an N - P junction (solar cell) is investigated in a configuration in which the beam scans the front surface of a solar cell crossing the ohmic contact strips. The analysis employs Fourier and Wiener-Hopf techniques and shows that even in the idealized case of uniform doping in both the N -material and the P -material the scanning electron beam gives little information about junction parameters (diffusion lengths, surface recombination velocities etc.). A recently proposed method for measuring the surface recombination velocity by means of changing the beam energy is inapplicable for shallow junctions (junction depth $\approx 0.1 \mu\text{m}$). The reason for this state of affairs is the fact that the radius of the beam-semiconductor interaction volume is larger than or comparable to the characteristic lengths, junction depth, depletion layer width and diffusion length of minority carriers in the N -material. The uncertainties of the distribution in space of excess carriers generated by the electron beam prevent an accurate determination of junction parameters. If, however, the ohmic contact on the back surface of a solar cell is partially removed, scanning across the free surface toward the ohmic contact yields useful information about the bulk diffusion length.

VON ROOS, O. H.

V028 Multilaterating the GEOS-3 Satellite

P. R. Escobal, J. F. Gallagher (Computer Sciences Corporation), and O. H. von Roos

J. Astronaut. Sci., Vol XXV, No 3, pp 227-249, July-September, 1977

For abstract, see Escobal, P. R.

VUSKOVIC, L.

V029 Electron Scattering by Highly Polar Molecules II. LiF

L. Vuskovic (Institute of Physics, Beograd, Yugoslavia), S. K. Srivastava, and S. Trajmar

J Phys B At Molec Phys, Vol 11, No 9,
pp 1643-1652, 1978

Utilising the crossed electron-beam-molecular-beam scattering technique, relative values of differential "elastic" scattering cross sections $\sigma(\theta)$ have been measured at electron impact energies of 5.4 and 20 eV for the angular range 20° to 130° . The absolute values of these cross sections have been obtained by normalisation to the classical perturbation theory of Dickinson at 40° scattering angle. These differential cross sections have then been used to calculate the integral and momentum-transfer cross sections.

An energy-loss spectrum at 100 eV electron impact energy and 15° scattering angle has also been obtained. Two weak features at the energy losses of 6.74 and 8.82 eV appear. Their energy positions are compared with the recent calculations of Kahn *et al*.

WACKLEY, J. A.

W001 Tracking Operations During the Voyager 2 Launch Phase

J. A. Wackley and G. L. Spradlin

The Deep Space Network Progress Report 42-44
January and February 1978, pp 273-288,
April 15, 1978

The Voyager 2 launch phase tracking operational procedures were carefully studied and conservatively designed to accommodate any launch contingency. This launch phase was marked by the first use of the Goldstone complex, including the 64 meter antenna, as the initial acquisition location. The report details the pre-launch planning for and subsequent analysis of tracking operations during the Voyager 2 launch phase.

WADA, B. K.

W002 Launch Vehicle Payload Interface Response

J. C. Chen, B. K. Wada, and J. A. Garba

J Spacecraft Rockets, Vol 15, No 1, pp 7-11,
January-February 1978

For abstract, see Chen, J. C.

WALKER, R. G.

W003 Infrared Astronomical Satellite

H. H. Aumann and R. G. Walker (Ames Research Center)

Opt Eng, Vol. 16, No. 6, pp. 537-543,
November-December 1977

For abstract, see Aumann, H. H.

WALLACE, C. J.

W004 Assessment of Free-Living Nitrogen Fixing Microorganisms for Commercial Nitrogen Fixation

B. O. Stokes and C. J. Wallace

JPL Publication 78-60, August 1, 1978

For abstract, see Stokes, B. O.

WALLIO, A.

W005 Viking Radio Occultation Measurements of the Martian Atmosphere and Topography: Primary Mission Coverage

G. Fjeldbo, D. Sweetnam, J. Brenkle,
E. Christensen, D. Farless, J. Mehta, B. Seidel,
W. Michael, Jr. (Langley Research Center),
A. Wallio (Langley Research Center), and
M. Grossi (Raytheon Company)

J Geophys Res, Vol 82, No 28, pp 4317-4324,
September 30, 1977

For abstract, see Fjeldbo, G.

WALLIS, D. E.

W006 FPLA Mechanization of Arithmetic Elements to Produce A + B or to Pass A Only

D. E. Wallis, H. Taylor, and A. L. Rubin

The Deep Space Network Progress Report 42-46
May and June 1978, pp 76-80, August 15, 1978

This article describes a 4-bit and a 3-bit adder which can be implemented under special hardware restrictions. The chip to be used is Field-Programmable Logic Array (FPLA) with 12 input lines, 50 AND gates inside, and output through only 6 OR gates. The context in which it is being used requires an "enable" function which can suppress one of the two numbers to be added. The 3-bit enabled adder is compatible with lookahead-carry mechanizations using the 74S182. It will be used in the accumulator for the RFI project.

WANG, P. K.

W007 Automated Mixed Traffic Vehicle (AMTV) Technology and Safety Study

A. R. Johnston, T. K. C. Peng, H. C. Vivian, and
P. K. Wang

JPL Publication 78-12, February 1978

For abstract, see Johnston, A R

WANG, T. G.

W008 Fourth-Order Acoustic Torque in Intense Sound Fields

T. G. Wang, H. Kanber, and E. E. Olli

J Acoust Soc Amer, Vol 63, No 5, pp 1332-1334, May 1978

This paper reports the first observation of a fourth-order acoustic torque in intense sound fields. The torque was determined by measuring the acoustically induced angular deflection of a polished cylinder suspended by a torsion fiber. This torque was measured in a sound field of amplitude greater than that in which first-order acoustic torque has been observed.

WARNE, L.

W009 Preliminary Studies of Electromagnetic Sounding of Cometary Nuclei

A. Gabriel, L. Warne, S. Bednarczyk, and C. Elachi

JPL Publication 78-44, October 1, 1978

For abstract, see Gabriel, A

WATSON, R. T.

W010 An Assessment of an F_2 or N_2O_4 Atmospheric Injection From an Aborted Space Shuttle Mission

R. T. Watson, P. E. Smokler, and W. B. DeMore

JPL Publication 77-81, April 15, 1978

If a Space Shuttle flight must be aborted before attaining escape velocity, the propellant for the payload would be ejected into the stratosphere or the ionosphere (which includes the mesosphere and the thermosphere).

Assuming a linear relationship between the stratospheric loading of NO_x and the magnitude of the ozone perturbation, we have calculated the change in ozone expected to result from the space shuttle ejection of N_2O_4 , based on the ozone change that is predicted for the (much greater) NO_x input that would accompany large-scale operations of SSTs. These calculations show that the effect on ozone is negligibly small.

The N_2O_4 may also be released in the ionosphere. Because of the localized and transient nature of the effects, it is concluded that this will result in no adverse environmental impacts.

We have critically reviewed possible stratospheric fluorine reactions to evaluate the magnitude of fluorine-induced ozone destruction relative to the reduction that would be caused by addition of an equal amount of chlorine. The predicted effect on stratospheric ozone is vanishingly small.

A similar evaluation was made for an ionosphere injection. No adverse environmental impacts are predicted.

WEBER, W. J., III

W011 Differential Encoding for Multiple Amplitude and Phase Shift Keying Systems

W. J. Weber III

IEEE Trans Commun, Vol COM-26, No 3, pp 385-391, March 1978

Because of the symmetry in most two-dimensional signal constellations, ambiguities exist at the receiver as to the exact phase orientation of the received signal set. In PSK systems, this ambiguity is resolved by the use of differential encoding. This paper presents differential encoding techniques which can be used with a variety of symmetric signal sets to remove their phase ambiguity. While not proven to be optimum, the techniques do have low performance penalties relative to the uncoded performance. The key to reducing the performance penalty is to use the minimum amount of differential encoding necessary to resolve the ambiguity. Examples of encoding techniques for several common signal constellations are given, including their performance penalties.

W012 A Bandwidth Compressive Modulation System Using Multi-Amplitude Minimum Shift Keying (MAMSK)

W. J. Weber III, P. H. Stanton, and J. T. Sumida

IEEE Trans Commun, Vol COM-26, No 5, pp 543-551, May 1978

A bandwidth compressive modem making use of multi-amplitude minimum shift keying (MAMSK) has been designed and implemented in a laboratory environment at microwave frequencies. This system achieves a substantial bandwidth reduction over binary PSK and operates within 0.5 dB of theoretical performance. A number of easily implemented microwave transmitters have been designed to generate the required set of 16 signals. The receiver has been designed to work at 1 Mbit/s and contains the necessary phase tracking, AGC, and symbol synchronization loops as well as a lock detector, SNR estimator and provisions for differential decoding. This paper describes this entire system and presents the experimental results.

WEISS, R. S.

- W013 Characterization of Solar Cells for Space Application: Electrical Characteristics of OCLI Violet Solar Cells as a Function of Intensity and Temperature**

T. A. Casad, R. G. Downing, and R. S. Weiss
JPL Publication 78-15, Vol I, March 15, 1978
For abstract, see Casad, T. A.

- W014 Characterization of Solar Cells for Space Applications. Electrical Characteristics of Solarex 50-Micron Solar Cells as a Function of Intensity and Temperature**

R. G. Downing, T. F. Miyahira, and R. S. Weiss
JPL Publication 78-15, Vol II, August 15, 1978
For abstract, see Downing, R. G.

- W015 Characterization of Solar Cells for Space Applications: Electrical Characteristics of OCLI Hybrid MLAR Solar Cells as a Function of Intensity and Temperature**

R. G. Downing and R. S. Weiss
JPL Publication 78-15, Vol III, September 1, 1978
For abstract, see Downing, R. G.

- W016 Characterization of Solar Cells for Space Applications: Electrical Characteristics of Spectrolab BSF 200-Micron Helios Cells as a Function of Intensity and Temperature**

R. G. Downing and R. S. Weiss
JPL Publication 78-15, Vol IV, November 1, 1978
For abstract, see Downing, R. G.

WEISSMAN, D. E.

- W017 Detection and Interpretation of Ocean Roughness Variations Across the Gulf Stream Inferred From Radar Cross Section Observations**

D. E. Weissman and T. W. Thompson
Oceans '77 Conference Record, pp 14B-1-14B-10, IEEE, New York, N. Y. and The Marine Technology Society, Washington, D. C., 1977

During the past several years, many radars have observed the distinct and interesting features associated with the Gulf Stream and its boundaries. Some of these Gulf Stream radar features have small scale, with dimensions comparable to and slightly greater than long gravity

waves. Other features are larger, with dimensions much greater than the length of long gravity waves. This study describes radar cross section variations within the Gulf Stream and just outside, seen with a 'scatterometer' type measurement.

The significant features of this radar cross section data were that the Gulf Stream always had a higher cross section per unit area (interpreted here as a greater roughness) than the water on the continental shelf. Also, a steep gradient in cross section was often seen at the expected location of the western boundary. There were also longer scale (10 to 20 km) gradual fluctuations within the stream of significant magnitude. These roughness variations are correlated with the surface shear stress that the local wind imposes on the sea. Using the available surface truth information regarding the wind speed and direction, an assumed Gulf Stream velocity profile, and high resolution ocean surface temperature data obtained by the Very High Resolution Radiometer onboard a NOAA-NESS polar-orbiting satellite (data provided by Dr. Richard Legeckus of NOAA-NESS), this study demonstrates that the computed surface stress variation bears a striking resemblance to the measured radar cross-section variations.

WELD, K. R.

- W018 Updated Z-Corrections for 64-m DSS Ground Station Delay Calibrations**

T. Y. Otoshi and K. R. Weld

The Deep Space Network Progress Report 42-47 July and August 1978, pp 77-84, October 15, 1978

For abstract, see Otoshi, T. Y.

WEN, L.

- W019 Thermal Optical Surface Properties and High-Temperature Solar Energy Conversion**

L. Wen

Preprint 78-903, Second AIAA/ASME Thermophysics Heat Transfer Conf., Palo Alto, Calif., May 24-26, 1978

The effects of thermal surface properties on the performance of representative point focusing solar power plants are assessed in this paper. The tradeoff relationships are presented in terms of normalized system performance as a function of thermal optical design parameters. Crucial surface properties include solar reflectance, specular spreading due to microscopic roughness, surface error due to manufacturing slope tolerance or waviness and concentrator pointing accuracy. Two representative

power conversion systems, a Rankine steam cycle and an open air Brayton cycle, are considered

Nature, Vol 270, No 5632, pp 36-37,
November 3, 1977

For abstract, see Ling, J C

WHERRY, D. B.

W020 A Synoptic Description of Coal Basins via Image Processing

K. W. Farrell, Jr. and D. B. Wherry

JPL Publication 78-82, September 1978

For abstract, see Farrell, K W, Jr

WIBERG, D. M.

W021 Statistical Error Analysis Using the UDU^T Covariance Factorization

C. L. Thornton and D. M. Wiberg (University of California, Los Angeles)

Proc IEEE Conf Decision and Control, New Orleans, La, Dec 7-9, 1977, Vol 1, pp 19-28

For abstract, see Thornton, C L.

WICKE, B. G.

W022 Electron-Impact Excitation of the Low-Lying Electronic States of HCN

A. Chutjian, H. Tanaka, B. G. Wicke (TRW Systems Group), and S. K. Srivastava

J Chem Phys, Vol 67, No 11, pp 4835-4839, December 1977

For abstract, see Chutjian, A.

WILCK, H. C.

W023 JPL 2²⁰ Channel 300 MHz Bandwidth Digital Spectrum Analyzer

G. A. Morris, Jr. and H. C. Wilck

The Deep Space Network Progress Report 42-46
May and June 1978, pp 57-61, August 15, 1978

For abstract, see Morris, G A., Jr

WILLETT, J. B.

W024 A Search for the Reported 400-keV γ -ray Line From Crab Nebula

J. C. Ling, W. A. Mahoney, J. B. Willett, and A. S. Jacobson

WILLIAMS, B. G.

W025 The Mass of Phobos From Viking Flybys

E. J. Christensen, G. H. Born,
C E. Hildebrand, and B. G. Williams

Geophys Res Lett, Vol 4, No 12, pp 555-557,
December 1977

For abstract, see Christensen, E J

WILLIAMS, D. S.

W026 The Robot's Eyes: Stereo Vision System for Automated Scene Analysis

D S. Williams

Proc SPIE, Vol 119, pp 15-20, 1977

The JPL Robotics Research Program is developing techniques that might be applicable in the future to planetary missions, to the assembly of large structures in earth orbit or to free swimming underwater vehicles where there is a need for the integration of a computer vision system with mechanical effectors. In each of these applications there is a need for real-time processing and a size limit on the on-board processor. To meet these objectives a robot stereo vision system was developed which maintains the image from the solid state detector television cameras in a dynamic random access memory (RAPID). The vision hardware provides, in effect, real time random access television cameras to the computer. Combining RAPID with the scene analysis algorithms optimized for the hardware provides a ten to twenty fold increase in processing speed over imaging systems which transfer the entire digital image to the computer and use the disc memory for intermediate storage. This short report describes the impact of the vision hardware on the stereo vision system and in turn the impact on the robot system.

WILLIAMS, R.

W027 Photoacoustic Spectroscopy of Organometallic Compounds With Applications in the Fields of Quasi-One-Dimensional Conductors and Catalysis

R. B. Somoano, A. Gupta, W. Volksen,
A Rembaum, and R. Williams (California Institute of Technology)

Organometallic Polymers, pp 165-174, Academic Press, Inc., New York, N Y, 1978

For abstract, see Somoano, R. B

W028 On the Crystal Phases of (DEPE) (TCNQ)₄

L. B. Coleman (University of California, Davis),
A. M. Hermann (Tulane University),
R. Williams (California Institute of Technology),
and R. B. Somoano

Phys Stat Sol (B), Vol 82, No 2, pp. K117-K121, 1977

For abstract, see Coleman, L. B

WILLIAMS, S.

W029 Application of Multispectral Radar and LANDSAT Imagery to Geologic Mapping in Death Valley

M. Daily, C. Elachi, T. Farr, W. Stromberg,
S. Williams, and G. Schaber (U S Geological Survey)

JPL Publication 78-19, March 30, 1978

For abstract, see Daily, M

WILLIAMS, W.

W030 Electron-Impact Cross Sections for Cu Atoms

S. Trajmar, W. Williams, and S. K. Srivastava

J Phys B At Mol Phys, Vol 10, No 16,
3323-3333, 1977

For abstract, see Trajmar, S

W031 Electron Impact Excitation of Magnesium at 10, 20 and 40 eV Impact Energies

W. Williams and S. Trajmar

J Phys B At Mol Phys, Vol 11, No 11,
pp 2021-2029, 1978

Normalized differential, integral and momentum-transfer cross sections for elastic scattering and for excitation of the 3^3P , 3^1P , 3^1D , 4^1S , 4^1P and ($3^3D + 3^3P$) states of magnesium have been determined at 10, 20 and 40 eV impact energies. Several autoionizing transitions have been observed in the 8-12 eV region of the energy-loss spectra which correlate well with optical-absorption and ejected-electron spectra.

W032 Elastic and Inelastic Scattering of Electrons by Atomic Manganese

W. Williams, J. C. Cheeseborough III (Claremont Men's College), and S. Trajmar

J Phys B At Mol Phys, Vol 11, No 11,
pp 2031-2036, 1978

Electron scattering by manganese has been studied in the 10-100 eV impact energy and 10-130° angular ranges. In certain energy and angular ranges we find that cross sections for several inelastic processes exceed those associated with elastic scattering. The angular distributions which characterise optically spin-allowed and spin-forbidden transitions involving singlet and triplet states in the case of light elements seem to apply to transitions among states of high spin multiplicity. Differential, integral and momentum-transfer cross sections for elastic scattering and excitation of the y^6P , z^6P , a^6D , a^4P , z^4P and z^8P states have been obtained at 20 eV impact energy. The cross sections were normalized to the absolute scale by using the optical f value of the z^6P excitation.

WILLIAMS, W. F.

W033 DSN 100-Meter X- and S-Band Microwave Antenna Design and Performance

W. F. Williams

JPL Publication 78-65, August 1, 1978

This report covers the studies made of the RF performance of large reflector antenna systems (100 meters) when using the high efficiency dual shaped reflector approach. The JPL Shaping Program has been updated to obtain more accurate results and to permit the shaping calculations of very large systems. A new technique was added to also improve blockage efficiency and a new program was prepared which altered phase so that the scattered field from a shaped surface could be used in the JPL efficiency program.

A new dual band (X-S) microwave feed horn is used in the shaping calculations. A great many shaping calculations were made for various horn sizes and locations and final RF efficiencies are reported. A conclusion is reached that when using the new dual band horn, shaping should probably be performed using the pattern of the lower frequency.

W034 A Prototype DSN X-S Band Feed. DSS 13 First Application Status

W. F. Williams

The Deep Space Network Progress Report 42-44
January and February 1978, pp 98-103, April 15, 1978

This article discusses a new prototype X-S band horn feed for future use at various DSN sites. This project was undertaken to more nearly optimize the X-band performance of these stations. This feed is a corrugated horn.

with extremely deep corrugation grooves that are suitable for both the X-band and S-band. The horn is very large, becoming gain limited, so that it performs about equally in both bands. A one-half scale model was fabricated and the measurement results were good reproductions of theoretical predictions. A full scale item has now been completed and will be tested at DSS 13.

W035 A Prototype DSN X-S Band Feed: DSS 13 Application Status (Second Report)

W. F. Williams

The Deep Space Network Progress Report 42-47, July and August 1978, pp 39-50, October 15, 1978

This article, the second in a series discussing a new prototype X-S band horn feed for future use at various DSN sites, deals with the combiner which was designed and fabricated for injecting X- and S-band into the horn. It also discusses predicted performance at DSS 13 by the calculated scattering of the model radiation patterns from the DSS 13 hyperbola.

The results indicate that the present version of the S-band combiner is much too narrow for use in both receiving and transmitting and that the horn patterns, when scattered, yield an improved efficiency over the present horn-hyperbola system.

WILLSON, R. C.

W036 Accurate Solar "Constant" Determinations by Cavity Pyrheliometers

R. C. Willson

J Geophys Res, Vol. 83, No. C8, pp. 4003-4007, August 20, 1978

Total solar irradiance was observed outside the earth's atmosphere by three types of absolute cavity pyrheliometer in a June 1976 sounding rocket experiment. The 1367 W/m² average solar "constant" result is uncertain by less than $\pm 0.5\%$, the most accurate determination to date. Nearly simultaneous observations by the Nimbus 6 earth radiation budget total irradiance detector of 1389 W/m² exceeded the rocket result by 1.6%. These recent results are discussed in the context of a summary of solar constant determinations made above the troposphere by cavity pyrheliometers.

WILSON, R. L.

W037 Final Report: Tissue Identification by Ultrasound

D. H. LeCrossette, R. C. Heyser, P. M. Gammell, and R. L. Wilson (Harbor General Hospital, Los Angeles, California)

JPL Publication 78-90, October 15, 1978

For abstract, see LeCrossette, D. H.

WINN, F. B.

W038 On the Suitability of Viking Differenced Range to the Determination of Relative Z-Distance

F. B. Winn

The Deep Space Network Progress Report 42-44, January and February 1978, pp 203-210, April 15, 1978

Radiometric differenced range residuals (10 Viking orbiting spacecraft observations) have been used to evaluate the current Deep Space Net adopted relative Z distance between Deep Space Station 43 and Deep Space Station 14. The $\Delta\rho$ noise is approximately twice the predicted noise $\sigma_{\Delta\rho}$ is 3.4 m relative to a mean of -1. This scatter in the $\Delta\rho$ is most likely due to media calibration uncertainties and Deep Space Net hardware noise.

These 10 $\Delta\rho$ residuals yield an estimated Z distance between DSS 43 and DSS 14 of 7351803.6 m. The standard deviation of that estimate is 10.1 m.

WOICESHYN, P. M.

W039 Dust Storms: Great Plains, Africa, and Mars

P. M. Woiceshyn, R. Krauss (University of Wisconsin, Madison), R. Minzner (Goddard Space Flight Center), and W. Shenk (Goddard Space Flight Center)

Proc Tenth AMS Conf Severe Local Storms, Omaha, Neb., October 18-21, 1977, pp 495-496

Dust storms in the Great Plains of North America and in the Sahara Desert are analyzed on the basis of imagery from the geostationary Synchronous Meteorological Satellite. The onset time, location, and areal extent of the dust storms are studied. Over land surfaces, contrast enhancement techniques are needed to obtain an adequate picture of dust storm development. In addition, infrared imagery may provide a means of monitoring the strong horizontal temperature gradients characteristic of dust cloud boundaries. Analogies between terrestrial dust storms and the airborne rivers of dust created by major Martian dust storms are also drawn.

WOLFE, J. H.

W040 Pioneer 10, 11 Observations of Evolving Solar Wind Streams and Shocks Beyond 1 AU

E. J. Smith and J. H. Wolfe (Ames Research Center)

Study of Travelling Interplanetary Phenomena/1977
Proc L D de Feiter Memorial Symposium, Tel
Aviv, Israel, June 7-10, 1977, pp 227-257

For abstract, see Smith, E J

WONG, P.

W041 JPL Energy Consumption Program (ECP)
Documentation. A Computer Model Simulating
Heating, Cooling and Energy Loads in Buildings

F. L. Lansing, V. W. Chai, S. N. Higgins,
D. Lasca, R. Urbanajo, and P. Wong

JPL Publication 78-76, September 15, 1978

For abstract, see Lansing, F L

WOO, K. T.

W042 Use of A Priori Statistics to Minimize Acquisition
Time for RFI Immune Spread Spectrum Systems

J. K. Holmes and K. T. Woo

The Deep Space Network Progress Report 42-46
May and June 1978, pp 62-69, August 15, 1978

For abstract, see Holmes, J K

WOO, R

W043 Probing the Solar Wind With Radio Measurements
of the Second Moment Field

R. Woo, F. Yang (Dikewood Corporation), and
A. Ishimaru (University of Washington)

Astrophys J, Vol 218, No 2, Part 1, pp 557-
568, December 1, 1977

The analysis presented in this paper is based on results for the second moment mutual coherence function obtained using the parabolic equation method. We examine the dependence of spectral broadening on anisotropic electron density irregularities and wind velocity fluctuations. We find that while these effects decrease the bandwidth of the spectrum over that for isotropic irregularities and no velocity fluctuations, the shape of the spectrum remains unchanged. An analysis for interpreting and relating angular broadening to spectral broadening (and other radio scattering observations) is provided, and it is seen that the properties of the solar wind deduced from both measurements are consistent, the spectrum of the electron density fluctuations is approximately power-law with a spectral index close to Kolmogorov. Simultaneous observations of angular and spectral broadening are useful since these would yield measurements of the velocity field. Finally, multiple-station observations of the correlation function of the total field or the mutual coherence

function are shown to be useful for measuring the solar wind velocity near the Sun. Such measurements can readily be made with spacecraft signals because they are coherent.

W044 Radial Dependence of Solar Wind Properties
Deduced From Helios 1/2 and Pioneer 10/11 Radio
Scattering Observations

R. Woo

Astrophys J, Vol 219, No 2, Part 1, pp 727-
739, January 15, 1978

In this paper we present the results of radio scattering measurements conducted at 2.3 GHz over an extensive heliocentric distance range (1.7-180 solar radii) of the solar wind using the Helios 1/2 and Pioneer 10/11 spacecraft. Spectral broadening has been observed closer to the Sun than ever before, and, when combined with the first measurement of angular broadening of a spacecraft signal, yields a solar wind velocity of 24 km s⁻¹ at 1.7 solar radii, a result that is estimated to be accurate to within a factor of 2-2.5. By assuming that the rms density fluctuation σ_{ne} is proportional to the mean density n_e , and using Saito's density model, we have obtained the velocity profile of the acceleration region of the solar wind. The results are consistent with the few existing velocity measurements made by other radio techniques as well as some existing theoretical models of the solar wind. Phase or Doppler scintillations, which are shown to be proportional to $\sigma_{ne} v^{5/6}$ (v is the solar wind velocity), have been measured out to 180 solar radii. Beyond 10 solar radii the radial dependence of the phase scintillations is roughly $R^{-1.3}$, and, within the assumptions that $\sigma_{ne} \propto n_e$ and $v^{5/6} \sim v$, suggest that the solar wind is slightly converging in the equatorial region between approximately 20 and 180 solar radii.

W045 Measurements of the Solar Wind Using Spacecraft
Radio Scattering Observations

R. Woo

Study of Travelling Interplanetary Phenomena/1977
Proc L D de Feiter Memorial Symposium, Tel
Aviv, Israel, June 7-10, 1977, pp 81-100

This paper reviews radio scattering measurements of the solar wind carried out with coherent, monochromatic, and point-source spacecraft signals. The observed phenomena which include spectral and angular broadening, and phase as well as intensity scintillations, have provided measurements of the solar wind previously not available from radio astronomical observations. These cover a wide range of heliocentric distances (as close as 1.7 solar radii), and large- as well as small-scale electron density fluctuations.

WOOLLAM, J. A.

W046 Physics and Chemistry of MoS₂ Intercalation Compounds

J. A. Woollam (Lewis Research Center) and
R. B. Somoano

Mater Sci Eng, Vol 31, pp 289-295,
December 1977

An investigation is made of the physics and chemistry of MoS₂ intercalation compounds. These compounds may be separated into two groups according to their stoichiometry, structure, and superconducting properties. The first group consists of Na, Ca, and Sr intercalates, and the second group consists of K, Rb, and Cs intercalates. Particular attention is given to the structure of the electronic energy band and to the normal state and superconducting properties of these compounds.

W047 Optical, Spin-Resonance, and Magnetoresistance Studies of (Tetrathiatetracene)₂(Iodide)₃. The Nature of the Ground State

R. B. Somoano, S. P. S. Yen, V. Hadek,
S. K. Khanna, M. Novotny (Stanford University),
T. Datta (Tulane University),
A. M. Hermann (Tulane University), and
J. A. Woollam (Lewis Research Center)

Phys Rev, Pt B Solid State, Vol 17, No 7, pp
2853-2857, April 1, 1978

For abstract, see Somoano, R. B.

WU, C

W048 Optimal Sampling and Quantization of Synthetic Aperture Radar Signals

C. Wu

JPL Publication 78-41, June 15, 1978

This paper presents some theoretical and experimental results on optimal sampling and quantization of synthetic aperture radar (SAR) signals. It includes a description of a derived theoretical relationship between the pixel signal-to-noise ratio of processed SAR images and the number of quantization bits per sampled signal, assuming homogeneous extended targets. With this relationship known, a solution may be realized for the problem of optimal allocation of a fixed data bit-volume (for specified surface area and resolution criterion) between the number of samples and the number of bits-per-sample. The results indicate that to achieve the best possible image quality for a fixed bit rate and a given resolution criterion, one should quantize individual samples coarsely and thereby maximize the number of multiple looks. The theoretical results are then compared with

simulation results obtained by processing aircraft SAR data.

WU, C. S.

W049 Plasma Fluctuations in the Solar Wind

M. Neugebauer, C. S. Wu (University of Maryland, College Park), and J. D. Huba (Naval Research Laboratory, Washington, D. C.)

J Geophys Res, Vol 83, No A3, pp 1027-1034,
March 1, 1978

For abstract, see Neugebauer, M.

WU, S. C.

W050 Frequency Selection and Calibration of a Water Vapor Radiometer

S. C. Wu

The Deep Space Network Progress Report 42-43
November and December 1977, pp 67-81,
February 15, 1978

The calibration coefficients of existing water vapor radiometers are dependent upon meteorology profiles. This is shown to be due mainly to incorrect frequency pairs. By properly selecting an optimum frequency pair, the dependency can be reduced to a relatively small amount which can be handily adjusted by surface measurement alone. Hence, a universal calibration equation is applicable to all environmental conditions—site, seasonal and diurnal variations. Optimum frequency pairs are systematically searched. Error analysis indicates that calibration for the water vapor phase delay accurate to <2 cm is possible at all elevation angles >15 degrees.

W051 Δ VLBI Spacecraft Tracking System Demonstration: Part I. Design and Planning

D. L. Brunn, R. A. Preston, S. C. Wu,
H. L. Siegel, D. S. Brown, C. S. Christensen, and
D. E. Hilt

The Deep Space Network Progress Report 42-45
March and April 1978, pp 111-132, June 15,
1978

For abstract, see Brunn, D. L.

W052 Microwave Radiometer Measurement of Water Vapor Path Delay Data Reduction Techniques

E. S. Claflin, S. C. Wu, and G. M. Resch

The Deep Space Network Progress Report 42-48
September and October 1978, pp 22-30,
December 15, 1978

For abstract, see Clafin, E S

YAGI, G. M.

Y001 IPL Processing of the Viking Orbiter Images of Mars

R. M. Ruiz, D. A. Elliott, G. M. Yagi,
R. B. Pomphrey, M A Power, K. W. Farrell, Jr ,
J. J. Lorre, W. D. Benton, R. E. Dewar, and
L. E. Cullen

J Geophys Res , Vol 82, No 28, pp 4189-4202,
September 30, 1977

For abstract, see Ruiz, R. M

YAKIMOVSKY, Y.

Y002 A System for Extracting Three-Dimensional Measurements From a Stereo Pair of TV Cameras

Y. Yakimovsky (University of Miami) and
R. Cunningham

Comput Graph Image Process , Vol 7, pp 195-
210, 1978

Obtaining accurate three-dimensional (3-D) measurement from a stereo pair of TV cameras is a task requiring camera modeling, calibration, and the matching of the two images of a real 3-D point on the two TV pictures. A system that models and calibrates the cameras and pairs the two images of a real-world point in the two pictures, either manually or automatically, was implemented at JPL. This system is operating and provides three-dimensional measurement resolution of ± 5 mm at distances of about 2 m

YANG, F.

Y003 Probing the Solar Wind With Radio Measurements of the Second Moment Field

R. Woo, F. Yang (Dikewood Corporation), and
A. Ishimaru (University of Washington)

Astrophys J , Vol 218, No 2, Part 1, pp 557-
568, December 1, 1977

For abstract, see Woo, R

YANOW, G.

Y004 Process Heat in California: Applications and Potential for Solar Energy in the Industrial, Agricultural and Commercial Sectors

R. H. Barbieri, R. E. Bartera, E. S. Davis,
G E. Hlavka, D. S. Pivrotto, and G. Yanow

JPL Publication 78-33, March 1978

For abstract, see Barbieri, R. H

YEH, Y. C. M.

Y005 A Schottky-Barrier Solar Cell on Sliced Polycrystalline GaAs

Y. C. M. Yeh and R. J. Stirn

Appl Phys Lett , Vol 33, No 5, pp 401-403,
September 1, 1978

Antireflecting-metal-oxide-semiconductor (AMOS) technology has been applied to sliced wafers of polycrystalline GaAs having grain sizes of about $100\ \mu\text{m}$. Simulated AM1 sunlight efficiencies up to 14% were obtained, and studies using the scanning electron microscope showed that grain boundaries have minimal effect on short-circuit current density. However, current-voltage characteristics show some influence on open-circuit voltage.

Y006 Progress Towards High Efficiency Polycrystalline Thin-Film GaAs AMOS Solar Cells

Y. C. M. Yeh, F. P. Ernest, and R. J. Stirn

Conf Rec Thirteenth IEEE Photovoltaic Spec Conf ,
Washington, D C , June 5-8, 1978, pp 966-971

Recently, single-crystal GaAs AMOS (Antireflecting Metal-Oxide-Semiconductor) solar cells have been reported to achieve an energy conversion efficiency of up to 17% for a fully gridded AR-coated cell. One of the most promising features of an AMOS structure is its adaptability to polycrystalline thin-film solar cells for terrestrial solar energy conversion in which the cost is the primary concern.

Energy conversion efficiency of 14% under AM1 illumination (ELH lamp) has been observed with an AMOS solar cell made on the sliced polycrystalline GaAs wafer with an average grain size of $100\ \mu\text{m}$ by $100\ \mu\text{m}$.

An energy conversion efficiency of 8% (4.8% without antireflection coating) has been realized with an AMOS solar cell made on CVD GaAs/recrystallized Ge/W substrate. Details of problems associated with the recrystallization and GaAs film growth are presented.

YEN, H. C

Y007 A Preliminary Model for High-Power Waveguide Arcing and Arc Protection

H. C. Yen

The Deep Space Network Progress Report 42-48
September and October 1978, pp 118-125,
December 15, 1978

This is the first article in a series describing the ongoing effort of the Transmitter Group to upgrade the arc protection subsystems that are, or will be, implemented in the DSN high-power transmitters. This article reviews the status of our present knowledge about waveguide arcs in terms of a simple engineering model and discusses a fairly general arc detection scheme. Areas where further studies are needed are pointed out along with our proposed approaches to the solutions of these problems.

YEN, S. P. S.

Y008 Labeled Cells

A. Rembaum, S. P. S. Yen, and
W. Volksen (IBM)

CHEMTECH, Vol 8, pp 182-190, March 1978

For abstract, see Rembaum, A

Y009 Optical, Spin-Resonance, and Magnetoresistance Studies of (Tetrathiatetracene)₂(Iodide)₃ The Nature of the Ground State

R. B. Somoano, S. P. S. Yen, V. Hadek,
S. K. Khanna, M. Novotny (Stanford University),
T. Datta (Tulane University),
A. M. Hermann (Tulane University), and
J. A. Woollam (Lewis Research Center)

Phys Rev, Pt B Solid State, Vol 17, No 7, pp
2853-2857, April 1, 1978

For abstract, see Somoano, R. B

Y010 Electrical Properties of (DEPE) (TCNQ)₄

R. B. Somoano, V. Hadek, S. P. S. Yen,
A. Rembaum, C. H. Hsu (California Institute of
Technology), R. J. Deck (Tulane University),
T. Datta (Tulane University), and
A. M. Hermann (Tulane University)

Phys Stat Sol (B), Vol 81, No 1, pp 281-286,
1977

For abstract, see Somoano, R. B

YEOMANS, D. K.

Y011 Comet Tempel 2: Orbit, Ephemerides and Error Analysis

D. K. Yeomans

JPL Publication 78-85, September 15, 1978

The dynamical behavior of comet Tempel 2 is investigated and the comet is found to be very well behaved and easily predictable. The nongravitational forces affecting the motion of this comet are the smallest of any comet that is affected by nongravitational forces. The sign and time history of these nongravitational forces imply (1) a direct rotation of the comet's nucleus and (2) the comet's ability to outgas has not changed substantially over its entire observational history. The well behaved dynamical motion of the comet, the well observed past apparitions, the small nongravitational forces and the excellent 1988 ground based observing conditions all contribute to relatively small position and velocity errors in 1988—the year of a proposed rendezvous space mission to this comet. To assist in planned ground based and earth orbital observations of this comet, ephemerides are given for the 1978-79, 1983-84 and 1988 apparitions.

YOUNG, L. E.

Y012 High-Power, Ultralow-Mass Solar Arrays: FY-77 Solar Arrays Technology Readiness Assessment Report

E. N. Costogoue, L. E. Young (Marshall Space
Flight Center), and H. Brandhorst (Lewis Research
Center)

JPL Publication 78-48, Vol I, June 15, 1978

For abstract, see Costogoue, E. N

Y013 High-Power, Ultralow-Mass Solar Arrays: FY-77 Solar Arrays Technology Readiness Assessment Report

E. N. Costogoue, L. E. Young (Marshall Space
Flight Center), and H. Brandhorst (Lewis Research
Center)

JPL Publication 78-48, Vol II, June 15, 1978

For abstract, see Costogoue, E. N

ZELDIN, B

Z001 Parametric Study of Two Planar High Power Flexible Solar Array Concepts

J. A. Garba, D. A. Kudija, B. Zeldin, and
E. N. Costogoue

JPL Publication 78-95, December 15, 1978

For abstract, see Garba, J. A.

Z002 New Concepts for Mercury Orbiter Missions

J. R. French, J. R. Stuart, and B. Zeldin

Preprint 78-79, AIAA Sixteenth Aerospace Sciences Meeting, Huntsville, Ala., January 16-18, 1978

For abstract, see French, J. R.

ZMUIDZINAS, J. S.

Z003 Formation of Metallic LiH

J. R. Vaisnys (Yale University) and
J. S. Zmuidzinas

Appl Phys Lett, Vol 32, No 3, pp 152-153,
February 1, 1978

For abstract, see Vaisnys, J. R.

Z004 Electron Trapping and Transport by Supersonic Solitons in One-Dimensional Systems

J. S. Zmuidzinas

Phys Rev, Pt B Solid State, Vol 17, No 10, pp
3919-3925, May 15, 1978

A one-dimensional chain of ions or molecules and electrons described by a Frohlich-type Hamiltonian with quartic phonon anharmonicities is investigated. It is shown that the anharmonic lattice supports supersonic solitons which under favorable circumstances may trap electrons and transport them along the lattice. For $\sigma \equiv d/l \sim 0.1$, where d is the lattice constant and l is the spatial extent of the soliton, rough estimates give electron trapping energies in the meV range. They imply a useful temperature range, up to tens of degrees K, for observing the new effect. The activation energy of a lattice soliton is proportional to the molecular mass and is therefore quite high (~ 1 eV) for typical quasi-one-dimensional organic systems.

ZOBRIST, A. J.

Z005 Elements of an Image-Based Information System

A. J. Zobrist and N. A. Bryant

Policy Anal Inform Syst, Knowledge Systems Laboratory, University of Illinois at Chicago, pp 71-90, 1978

There is a pressing need for systems which can manage spatially-referenced data and perform certain types of spatially-oriented processing. As an example census data is spatially referenced, and there is a standard repertoire

of computational steps performed by users of those data such as aggregation of variables over regions defined by polygons. The IBIS (Image-Based Information System) extends the capability of present systems by adding a new data-type, the image raster, in such a way that it can be used with tabular data bases. Many of the existing computational procedures are simplified or made more accurate when converted to a digital image processing mode of operation and several new computational procedures are made possible. In addition, new methods of data capture and new sources of data are added (e.g., photo-scanning and satellite imagery).

The system is now in use on a test basis. Its first applications include the tabulation of land use by census tract for Los Angeles and Orange Counties, California, from information contained in satellite imagery. This report describes a more advanced test case in progress for Portland, Oregon.

ZOUTENDYK, J. A.

Z006 Theoretical Analysis of Heat Flow in Horizontal Ribbon Growth From a Melt

J. A. Zoutendyk

J Appl Phys, Vol 49, No 7, pp 3927-3932,
July 1978

A theoretical heat flow analysis for horizontal ribbon growth is presented. Equations are derived relating pull speed, ribbon thickness, thermal gradient in the melt, and melt temperature for limiting cases of heat removal by radiation only and isothermal heat removal from the solid surface over the melt. Geometrical cross sections of the growth zone are shown to be triangular and nearly parabolic for the two respective cases. Theoretical pull speed for silicon ribbon 0.01 cm thick, where the loss of latent heat of fusion is by radiation to ambient temperature (300 K) only, is shown to be 1 cm/sec for horizontal growth extending 2 cm over the melt and with no heat conduction either to or from the melt. Further enhancement of ribbon growth rate by placing cooling blocks adjacent to the top surface is shown to be theoretically possible.

Z007 Development of Low-Cost Silicon Crystal Growth Techniques for Terrestrial Photovoltaic Solar Energy Conversion

J. A. Zoutendyk

Solar Energy, Vol 20, pp 249-257, 1978

Single crystal silicon solar cells are potential elements of large scale solar energy conversion systems. Current costs of these cells are too high at least in part because current production methods require single crystal wafers obtained by slicing cylindrical single crystal ingots. This

paper reviews a U S research program aimed at reducing the cost of silicon cells by developing new methods of growing silicon ribbons and sheets from which high efficiency solar cells can be fabricated The paper also describes novel techniques for lower cost processes for ingot growth and wafer slicing which are included in this research and development program

ZUCKERMAN, B.

2008 Deuterated Ammonia Toward the Orion Nebula

E. N. R. Kuiper (University of California, Los Angeles), B. Zuckerman (University of Maryland), and T. B. H. Kuiper

Astrophys J, Vol 219, pp L49–L53, January 1, 1978

For abstract, see Kuiper, E. N. R.

2009 Spectral Line Shapes in Spherically Symmetric Radially Moving Clouds

T. B. H. Kuiper, E. N. R. Kuiper (University of California, Los Angeles), and B. Zuckerman (University of Maryland)

Astrophys J, Vol 219, pp 129–140, January 1, 1978

For abstract, see Kuiper, T. B. H.

ZUREK, R. W.

2010 Solar Heating of the Martian Dusty Atmosphere

R. W. Zurek

Icarus, Vol 35, pp 196–208, 1978

This paper examines the solar heating of the Martian atmosphere during the 1971 global dust storm observed by Mariner 9 Radiative scattering as well as absorption is included by utilizing the delta-Eddington approximation to the full radiative transfer equation The necessary optical parameters are generated by a Mie program which uses a size distribution and a complex refractive index inferred from a number of sources, particularly from recent analyses of Mariner 9 UVS and TV observations Assuming uniform mixing of the dust, the solar heating per unit mass during a Martian global dust storm is remarkably uniform with height for small solar zenith angles Heating rates may reach $80^{\circ}\text{K day}^{-1}$ for overhead sunlight Overall, 20% of the direct insolation is absorbed by the dust-laden atmosphere Even optically thin widespread dust hazes may produce heating rates of several degrees Kelvin per day

ZYGIELBAUM, A. I.

2011 On Improved Ranging

J. W. Layland, A. I. Zygielbaum, and W. P. Hubbard

The Deep Space Network Progress Report 42-46
May and June 1978, pp 40–45, August 15, 1978

For abstract, see Layland, J. W.

Subject Index

Subject Categories

Acoustics
Administration and Management
Aeronautics (General)
Aircraft Communications and Navigation
Aircraft Design, Testing, and Performance
Aircraft Instrumentation
Aircraft Propulsion and Power
Air Conditioning, Heating, Lighting, and Ventilating
Air Transportation and Safety
Apollo Project
Astrodynamics
Astronautics (General)
Astronomy
Astrophysics
Atomic and Molecular Physics

Behavioral and Social Sciences (General)
Biochemistry
Bioengineering
Biological and Medical Sciences (General)
Biology

Celestial Mechanics
Ceramics, Refractories, and Glasses
Chemistry (General)
Clinical Medicine
Communications
Components
Composite Materials
Computer Operations and Hardware
Computer Programming and Software
Computer Systems
Conversion Techniques
Cost Effectiveness
Crystallography
Cybernetics

Documentation and Information Technology
Dynamic Oceanography

Earth Resources
Economics
Electronics and Electrical Engineering
Energy (General)
Energy Production
Energy Storage
Engineering (General)
Environmental Biology
Environment Pollution

Fluid Mechanics and Heat Transfer

Geodesy
Geology and Mineralogy
Geophysics
Geosciences and Oceanography (General)
Ground Support Systems and Facilities (Space)
Ground Transportation
Equipment

Helios Project
History, Law, and Political Science
Human-System Technology
Hydrology and Limnology

Information Theory
Instrumentation and Photography

Jet and Gas Turbine Engines

Laboratories, Test Facilities, and Test Equipment
Lasers and Masers

Launch Vehicles and Space Vehicles
Lunar and Planetary Exploration (Advanced)
LANDSAT Project

Mariner Jupiter/Saturn 1977 Project
Mariner Venus/Mercury 1973 Project
Materials (General)
Mathematical and Computer Sciences (General)
Mechanical Engineering
Metallurgy and Metallography
Meteorology and Climatology
Microbiology
Mining Engineering
Missile Technology (General)

Navigation and Guidance
Nuclear and High Energy Physics
Nuclear Science and Technology (General)
Numerical Analysis

Optical Detection
Optics
Organic Chemistry

Particle Physics
Physical Chemistry
Physical Oceanography
Physics (General)
Pioneer Project
Planetary Biology
Plasma Physics
Plastics
Power Sources
Propulsion and Fuels (General)
Pumps, Filters, Pipes, Fittings, Tubing, and Valves

Quality Assurance and Reliability
Quantum Theory

Radar Detection
Reliability
Research and Support Facilities
Rocket Motors and Engines
Rocket Propellants
Rubbers

Safety Engineering
Snow, Ice, Permafrost
Solar Physics
Solid Mechanics

Solid-State Physics
Spacecraft Communications,
Command, and Tracking
Spacecraft Design, Testing, and
Performance
Spacecraft Instrumentation
Spacecraft Propulsion and Power
Space Radiation
Space Sciences (General)
Statistics and Probability
Stress Physiology
Structural Engineering
Subsystems
Systems Analysis

SEASAT-A Project

Theoretical Mathematics
Thermodynamics and Statistical
Physics

Urban Technology and
Transportation

Viking Mars 1975 Project
Voyager Project

Wave Propagation

Subjects

| Subject | Entry | Subject | Entry |
|--|-------|--|-------|
| Acoustics | | | |
| new technique for single-scan T_1 measurements using solid echoes | B077 | influence of internally generated pure tones on the broadband noise radiated from a jet | P004 |
| nitramine smokeless propellant research—annual research progress report | C032 | Air Conditioning, Heating, Lighting, and Ventilating | |
| final report tissue identification by ultrasound | L020 | JPL energy consumption program (ECP) | |
| influence of internally generated pure tones on the broadband noise radiated from a jet | P004 | documentation a computer model simulating heating, cooling and energy loads in buildings | L004 |
| effect of ultrasonic irradiation on mammalian cells and chromosomes <i>in vitro</i> | R053 | Air Transportation and Safety | |
| photoacoustic spectroscopy of condensed matter | S053 | analysis of DOT near-term transportation research, development, and demonstration activities | B004 |
| photoacoustic spectroscopy of organometallic compounds with applications in the fields of quasi-one-dimensional conductors and catalysis | S055 | enclosure fire hazard analysis using relative energy release criteria | C044 |
| fourth-order acoustic torque in intense sound fields | W008 | application of the relative energy release criteria to enclosure fire testing | R052 |
| Administration and Management | | Aircraft Communications and Navigation | |
| process heat in California applications and potential for solar energy in the industrial, agricultural and commercial sectors | B006 | applications of modern estimation techniques to aircraft navigation | B053 |
| evaluation of the DSN software methodology | I003 | RPV application of a globally adaptive rate controlled compressor | R040 |
| evaluation of the developing DSN life-cycle cost standard practice | M034 | Aircraft Design, Testing, and Performance | |
| life cycle costing with a discount rate | P022 | analysis of a suspension system for a wheel rolling on a flat track | M032 |
| a life cycle cost economics model for automation projects with uniformly varying operating costs | R021 | Aircraft Instrumentation | |
| an effective procurement and financial management reporting system | R056 | application of CCD technology to produce imagery from radar data | A021 |
| historical evidence of importance to the industrialization of flat-plate silicon photovoltaic systems executive summary | S045 | bandwidth compression of synthetic aperture radar imagery by quantization of raw radar data | L042 |
| historical evidence of importance to the industrialization of flat-plate silicon photovoltaic systems | S046 | Aircraft Propulsion and Power | |
| some data relationships among diverse areas of the DSN and JPL | S048 | pressure pulsations on a flat plate normal to an underexpanded supersonic jet | B001 |
| standardized development of computer software part II standards | T003 | influence of internally generated pure tones on the broadband noise radiated from a jet | P004 |
| elements of an image-based information system | Z005 | Apollo Project | |
| | | thorium concentrations in the lunar surface I regional values and crustal content | M044 |
| Aeronautics (General) | | Astrodynamics | |
| application of CCD technology to produce imagery from radar data | A021 | a demonstration of dual spacecraft tracking conducted with the Viking spacecraft during the approach phase | C012 |
| enclosure fire hazard analysis using relative energy release criteria | C044 | mission applications of the dual spacecraft tracking technique | C013 |
| final report of the ad hoc Mars airplane science working group | J029 | | |

| Subject | Entry | Subject | Entry |
|---|-------|---|-------|
| a demonstration of differenced dual-station one-way doppler conducted with Pioneer 11 | C014 | spectral line shapes in spherically symmetric radially moving clouds | K036 |
| orbit trim maneuver design and implementation for the 1975 Mars Viking mission | H035 | carbon recombination-line mapping of the Orion nebula | K037 |
| a reformulation of the Linear-Quadratic-Gaussian stochastic control problem for application to low thrust navigation analysis | J003 | identification of water frost on Callisto | L019 |
| elements of solar sail navigation with application to a Halley's comet rendezvous | J005 | Galilean satellites analysis of photometric eclipses | L036 |
| interplanetary approach optical navigation with applications | J016 | a search for the reported 400-keV γ -ray line from crab nebula | L041 |
| an overview of Viking navigation | O002 | automated radio astronomy operations | L046 |
| estimates of precession and polar motion errors from planetary encounter station location solutions | P005 | application of digital image processing techniques to astronomical imagery 1977 | L050 |
| Astronautics (General) | | application of digital image processing techniques to astronomical imagery 1978 | L051 |
| missions to comets an options review | A024 | enhancement of the jets in NGC 1097 | L052 |
| the ion drive program competition as the key to development progress | A025 | preliminary design work on a DSN VLBI correlator | L055 |
| the role of robots and automation in space | H015 | soil maturity and planetary regoliths the Moon, Mercury, and the asteroids | M019 |
| Voyager mission description | K027 | asteroids and comparative planetology | M022 |
| infrared astronomical satellite | M036 | images of Io's sodium cloud | M023 |
| an overview of Viking navigation | O002 | a tutorial introduction to very long baseline interferometry (VLBI) using bandwidth synthesis | M058 |
| system design of an ion drive spacecraft | S089 | JPL 220 channel 300 MHz bandwidth digital spectrum analyzer | M061 |
| Astronomy | | VLBI-laser intercomparison project | M068 |
| an improved lunar moment of inertia determination a proposed strategy | A015 | extraterrestrial intelligence an observational approach | M069 |
| infrared astronomical satellite | A026 | postperihelion interference filter photometry of the "annual" comet P/Encke | N009 |
| D/H & C/H ratios in Jupiter from CH ₃ D phase | M036 | CCIR paper on the radiocommunications requirements for systems to search for extraterrestrial life | N013 |
| a brief historical introduction to very long baseline interferometry | B019 | estimates of precession and polar motion errors from planetary encounter station location solutions | P005 |
| an extensive bibliography on long baseline interferometry | B023 | an entree for large space antennas | P025 |
| a white-light amplitude interferometer with 180-degree rotational shear | B024 | establishing a celestial VLBI reference frame—I searching for VLBI sources | P028 |
| sodium D-line emission from Io comparison of observed and theoretical line profiles | B062 | equipotential doming in flooded circular basins on the Moon | R055 |
| Deimos Encounter by Viking preliminary imaging results | C005 | the compact radio sources in 4C 39 25 and 3C 345 | S017 |
| absolute flux density calibrations of radio sources 2.3 GHz | D047 | Pioneer 10, 11 observations of evolving solar wind streams and shocks beyond 1 AU | S042 |
| absolute flux density calibrations receiver saturation effects | F029 | the tone generator and phase calibration in VLBI measurements | T012 |
| preliminary studies of electromagnetic sounding of cometary nuclei | F030 | Viking first encounter of Phobos preliminary results | T022 |
| a TiO ₂ abundance map for the northern maria | G001 | visual and infrared photometry of asteroids | V007 |
| evidence of an increase in the microwave brightness temperature of Uranus | J037 | | |
| deuterated ammonia toward the Orion nebula | K021 | | |
| | K033 | | |

| Subject | Entry | Subject | Entry |
|--|-------|---|-------|
| comet Tempel 2 orbit, ephemerides and error analysis | Y011 | application of digital image processing techniques to astronomical imagery 1977 | L050 |
| Astrophysics | | application of digital image processing techniques to astronomical imagery 1978 | L051 |
| an interpretation of Mariner 10 helium (584 Å) and hydrogen (1216 Å) interplanetary emission observations | A009 | effect of a changing G on the moment of inertia of the earth | L059 |
| an improved lunar moment of inertia determination a proposed strategy | A015 | on the accelerations of the Moon and Sun, the constant of gravitation, and the origin of mountains | L060 |
| tests of general relativity using astrometric and radio metric observations of the planets | A017 | asteroids and comparative planetology | M022 |
| Venus in motion | A019 | images of Io's sodium cloud | M023 |
| D/H & C/H ratios in Jupiter from CH ₃ D phase | B019 | plasma fluctuations in the solar wind | N008 |
| a brief historical introduction to very long baseline interferometry | B023 | the composition of Phobos: evidence for carbonaceous chondrite surface from spectral analysis | P002 |
| an extensive bibliography on long baseline interferometry | B024 | multicolor observations of Phobos with the Viking lander cameras evidence for a carbonaceous chondritic composition | P019 |
| intensity and pressure shift of the H ₂ (4,0) S(1) quadrupole line | B029 | establishing a celestial VLBI reference frame—I searching for VLBI sources | P028 |
| deep space telecommunications and the solar cycle a reappraisal | B032 | equipotential doming in flooded circular basins on the Moon | R055 |
| electron density and doppler RMS phase fluctuation in the inner corona | B035 | the compact radio sources in 4C 39 25 and 3C 345 | S017 |
| solar wind density fluctuation and the experiment to detect gravitational waves in ultraprecise doppler data | B037 | observations of the interplanetary sector structure up to heliographic latitudes of 16° Pioneer 11 | S041 |
| solar wind turbulence models evaluated via observations of doppler RMS phase fluctuation and spectral broadening in the inner corona | B038 | Pioneer 10, 11 observations of evolving solar wind streams and shocks beyond 1 AU | S042 |
| the gravitational wave detection experiment description and anticipated requirements | B039 | probing the solar wind with radio measurements of the second moment field | W043 |
| simultaneous dual-frequency, round-trip calibration of Doppler data with application to radio science experiments | B044 | radial dependence of solar wind properties deduced from Helios 1/2 and Pioneer 10/11 radio scattering observations | W044 |
| the ISEE-C vector helium magnetometer absolute flux density calibrations of radio sources 2.3 GHz | F028 | measurements of the solar wind using spacecraft radio scattering observations | W045 |
| absolute flux density calibrations receiver saturation effects | F029 | Atomic and Molecular Physics | |
| testing relativistic theories of gravity with spacecraft-Doppler gravity-wave detection | F030 | intensity and pressure shift of the H ₂ (4,0) S(1) quadrupole line | B029 |
| evidence of an increase in the microwave brightness temperature of Uranus | H020 | cross sections for electron impact of N ₂ | C007 |
| deuterated ammonia toward the Orion nebula | K021 | electron-impact excitation of the low-lying electronic states of HCN | C027 |
| spectral line shapes in spherically symmetric radially moving clouds | K033 | the rotational spectrum and molecular parameters of ClO in the $v = 0$ and $v = 1$ states | K002 |
| carbon recombination-line mapping of the Orion nebula | K036 | absolute rate and temperature dependence of the reaction between chlorine (² P) atoms and methane | K016 |
| a search for the reported 400-keV γ -ray line from crab nebula | K037 | deuterated ammonia toward the Orion nebula | K033 |
| | L041 | spectral line shapes in spherically symmetric radially moving clouds | K036 |

| Subject | Entry | Subject | Entry |
|---|----------|---|------------|
| variable fragmentation mass spectrometry using chemi-ionization | L011 | effect of ultrasonic irradiation on mammalian cells and chromosomes <i>in vitro</i> | R053 |
| bandstrength determination of the fundamental vibration-rotation spectrum of ClO | M010 | assessment of free-living nitrogen fixing microorganisms for commercial nitrogen fixation | S084 |
| absorption strength of the perturbed ν_4 band of CH ₃ Cl | ... M012 | | |
| calculation of spin-lattice relaxation during pulsed spin locking in solids | .R036 | Biology | |
| electrical properties of (DEPE) (TCNQ) ₄ | S057 | thermal resistance of naturally occurring airborne bacterial spores | P032 |
| elastic scattering of intermediate energy electrons by HCN. | S064 | a model for sensorimotor control and learning | .R002 |
| experimental differential and integral electron impact cross sections for B $1\Sigma_u^+$ State of H ₂ in intermediate-energy region | S066 | Celestial Mechanics | |
| electron scattering by metal vapors | T024 | tests of general relativity using astrometric and radio metric observations of the planets | .A017 |
| electron-impact cross sections for Cu atoms | .T027 | comet Tempel 2: orbit, ephemerides and error analysis | Y011 |
| formation of metallic LiH | ..V002 | | |
| electron scattering by highly polar molecules II. LiF | ... V029 | Ceramics, Refractories, and Glasses | |
| electron impact excitation of magnesium at 10, 20 and 40 eV impact energies | W031 | compatibility studies of various refractory materials in contact with molten silicon | O001 |
| elastic and inelastic scattering of electrons by atomic manganese | W032 | silicones as high temperature insulators | .P016 |
| physics and chemistry of MoS ₂ intercalation compounds | W046 | | |
| Behavioral and Social Sciences (General) | | Chemistry (General) | |
| the diffusion of the use of new energy technology as a context for an overview of solar energy technologies | H038 | a multiple pulse zero crossing NMR technique, and its application to ¹⁹ F chemical shift measurements in solids | ... B076 |
| an overview of U.S energy options supply-and-demand-side history and prospects. | .. H039 | electron-impact excitation of the low-lying electronic states of HCN. | C027 |
| historical evidence of importance to the industrialization of flat-plate silicon photovoltaic systems executive summary | .S045 | hydrogen enrichment for low-emission jet combustion | C030 |
| historical evidence of importance to the industrialization of flat-plate silicon photovoltaic systems | ... S046 | continuous extrusion of coal | E017 |
| Biochemistry | | coal desulfurization by low-temperature chlorinolysis | H049 |
| synthesis and biological screening of novel hybrid fluorocarbon hydrocarbon compounds for use as artificial blood substitutes | .M056 | Jet Propulsion Laboratory 1976-1977 annual report | J021 |
| labeled cells | R016 | JPL basic research review | J027 |
| Bioengineering | | final report for Phase I-coal desulfurization by low temperature chlorinolysis.. . . . | ... K004 |
| final report tissue identification by ultrasound. | L020 | storage, transmission and distribution of hydrogen. | K011 |
| Biological and Medical Sciences (General) | | variable fragmentation mass spectrometry using chemi-ionization | L011 |
| synthesis and biological screening of novel hybrid fluorocarbon hydrocarbon compounds for use as artificial blood substitutes | .. M056 | rate constant for the reaction ClO + NO → Cl + NO ₂ | .. L031 |
| labeled cells | R016 | ultraviolet absorption cross sections of hydrogen peroxide | L037 |
| | | rate constant for the reaction of atomic chlorine with methane | L038 |
| | | synthesis and biological screening of novel hybrid fluorocarbon hydrocarbon compounds for use as artificial blood substitutes | M056 |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| development and evaluation of elastomeric materials for geothermal applications—annual report, October 1976–October 1977 | M066 | Helios mission support (contd) | G030 |
| compatibility studies of various refractory materials in contact with molten silicon labeled cells | O001 | fiber optic rotation sensor (FORS) signal detection and processing. | G032 |
| calculation of spin-lattice relaxation during pulsed spin locking in solids | R016 | an iterative algorithm for decoding block codes transmitted over a memoryless channel | G035 |
| hydrogen from the solar photolysis of water | R036 | examination of the DSN X-band weather specifications | G036 |
| new method of feeding coal continuous extrusion of fully plastic coal | R065 | new X-band microwave equipment at the DSN 64-meter stations | H011 |
| elastic scattering of intermediate energy electrons by HCN | R066 | a new, nearly free, clock synchronization technique | H028 |
| thermal optical surface properties and high-temperature solar energy conversion | S064 | use of a priori statistics to minimize acquisition time for RFI immune spread spectrum systems | H044 |
| physics and chemistry of MoS ₂ intercalation compounds | W019 | GCF HSD error control | H053 |
| Clinical Medicine | W046 | orbiting deep space relay station, a study report | H054 |
| final report tissue identification by ultrasound | L020 | Pioneer mission support | J042 |
| Communications | | predetection telemetry analog recording and playback for Pioneer Venus 1978 | K015 |
| implementation of automated fault isolation test programs for maximum likelihood convolutional decoder (MCD) maintenance | A012 | an alternate technique for near-Sun ranging on improved ranging | L015 |
| stochastic processes, estimation theory, and image enhancement | A022 | convolutional coding results for the MVM '73 X-band telemetry experiment. | L016 |
| soft decision decoding of block codes | B016 | tracking loop and modulation format considerations for high rate telemetry | L029 |
| radio-frequency carrier arraying for high-rate telemetry reception | B064 | bandwidth compression of synthetic aperture radar imagery by quantization of raw radar data | L042 |
| Pioneer Venus 1978 Deep Space Network telecommunications compatibility test program status | B068 | on the determination and investigation of the terrestrial ionospheric refractive indices using GEOS-3/ATS-6 satellite-to-satellite tracking data | L044 |
| large active retrodirective arrays for space applications | C021 | preliminary design work on a DSN VLBI correlator | L055 |
| CCIR papers on telecommunications for deep space research | D013 | CCM implementation status | M008 |
| radio frequency interference between spacecraft in different missions | D014 | a public-key cryptosystem based on algebraic coding theory | M026 |
| DSN ground communications facility. | E027 | the Lovasz bound and some generalizations | M027 |
| absolute flux density calibrations of radio sources 2.3 GHz | F029 | JPL 220 channel 300 MHz bandwidth digital spectrum analyzer | M061 |
| absolute flux density calibrations receiver saturation effects | F030 | extraterrestrial intelligence an observational approach | M069 |
| synthesis of a laterally displaced cluster feed for a reflector antenna with application to multiple beams and contoured patterns | G002 | CCIR paper on the radiocommunications requirements for systems to search for extraterrestrial life | N013 |
| network operations control center block III modifications | G010 | an entree for large space antennas | P025 |
| Helios mission support | G025 | on estimating the phase of a periodic waveform in additive gaussian noise—Part I | R003 |
| | G026 | a fast DFT algorithm using complex integer transforms | R004 |
| | G027 | | |

| Subject | Entry | Subject | Entry |
|--|-------|--|-------|
| transform decoding of Reed-Solomon codes over $GF(2^{2^n})$ using the techniques of Winograd | R005 | Components a review of the state of the art in large spaceborne antenna technology | S039 |
| on decoding of Reed-Solomon codes over $GF(32)$ and $GF(64)$ using the transform techniques of Winograd | R006 | Composite Materials development and evaluation of elastomeric materials for geothermal applications—annual report, October 1976–October 1977 | M066 |
| a new hybrid algorithm for computing a fast discrete fourier transform | R007 | | |
| a new algorithm for computing primitive elements in $GF(q^2)$ | R008 | Computer Operations and Hardware spacecraft subsystem checkout by minicomputer | A016 |
| a fast computation of complex convolution using a hybrid transform | R009 | UNIBUS monitor for PDP 11 | D031 |
| a simplified algorithm for correcting both errors and erasures of R-S codes | R010 | network operations control center block III modifications | G010 |
| network functions and facilities | R027 | a distributed microprocessor system for topographic imaging of the ocean floor | H010 |
| | R028 | development support—DSS 13 S-X unattended systems development | J001 |
| | R029 | implementation of the radio science subsystem in the DSN | K018 |
| | R030 | preliminary design work on a DSN VLBI correlator | L055 |
| network telemetry system performance tests in support of the Mark III data system implementation | R031 | CCM implementation status | M008 |
| DSN portable zero delay assembly | R032 | reconfigurable modular computer networks for spacecraft on-board processing | R024 |
| an algorithm for generating an m -ary summation tree | S016 | a distributed microprocessor system for spacecraft control and data handling | R025 |
| the false lock performance of Costas loops with hard-limited in-phase channel | S026 | a study of standard building blocks for the design of fault-tolerant distributed computer systems | R026 |
| on the calculation of squaring loss in Costas loops with arbitrary arm filters | S027 | an algorithm for generating an m -ary summation tree | S026 |
| tracking performance of Costas loops with hard-limited in-phase channel | S028 | ionizing radiation effects on SBP9900 microprocessor | S071 |
| temperate zone sporadic- E maps ($f_oE_s > 7$ MHz) | S029 | SEM analysis of ionizing radiation effects in linear integrated circuits | S072 |
| three-channel integrating analog-to-digital converter | S043 | DSN monitor and control system, Mark III-78 | S080 |
| DSN command system Mark III-78 | S077 | FPLA mechanization of arithmetic elements to produce $A + B$ or to pass A only | W006 |
| DSN monitor and control system, Mark III-78 | S079 | the robot's eyes stereo vision system for automated scene analysis | W026 |
| Deep Space Network to Viking Orbiter telecommunications performance during the Viking extended mission, November 1976 through February 1978 | S080 | elements of an image-based information system | Z005 |
| differential encoding for multiple amplitude and phase shift keying systems | T005 | Computer Programming and Software computer image processing—geologic applications | A002 |
| a bandwidth compressive modulation system using multi-amplitude minimum shift keying (MAMSK) | W011 | spacecraft subsystem checkout by minicomputer | A016 |
| a prototype DSN X-S band feed DSS 13 first application status | W012 | a parameter estimation subroutine package | B050 |
| a prototype DSN X-S band feed DSS 13 application status (second report) | W034 | algorithms for isolating worst case systematic data errors | C052 |
| | W035 | multilaterating the GEOS-3 satellite | E022 |
| | | network operations control center block III modifications | G010 |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| a distributed microprocessor system for topographic imaging of the ocean floor | H010 | reconfigurable modular computer networks for spacecraft on-board processing . . | R024 |
| GCF HSD error control . . . | H053 | a distributed microprocessor system for spacecraft control and data handling . | R025 |
| evaluation of the DSN software methodology development support—DSS 13 S-X unattended systems development . | I003 | a study of standard building blocks for the design of fault-tolerant distributed computer systems . . . | R026 |
| standard practices for the implementation of computer software . . . | J001 | MBASIC™ batch processor architectural overview. | R035 |
| proceedings conference on the programming environment for development of numerical software . . . | J023 | an algorithm for generating an <i>m</i> -ary summation tree | S026 |
| photomask and pattern programming manual . | J030 | DSN command system Mark III-78 | S079 |
| JPL energy consumption program (ECP) documentation a computer model simulating heating, cooling and energy loads in buildings . . . | K019 | DSN monitor and control system, Mark III-78 . | S080 |
| automated radio astronomy operations . | L004 | DSN test and training system, Mark III-77 | T015 |
| application of digital image processing techniques to astronomical imagery 1977 .. | L046 | Conversion Techniques | |
| DSN system performance test software | L050 | the Goldstone Energy Project final report . . | B010 |
| a distributed microprocessor system for spacecraft control and data handling | M014 | potential for cogeneration of heat and electricity in California industry—Phase I final report | D010 |
| network telemetry system performance tests in support of the Mark III data system implementation . | R025 | microwave power transmitting phased array antenna research project summary report | D025 |
| MBASIC™ batch processor architectural overview | R034 | SPS microwave subsystem potential impacts and benefits . . . | D027 |
| the DSN standard real-time language . | R035 | coal desulfurization by low-temperature chlorinolysis . | H049 |
| parallel compilation a design and its application to SIMULA 67 | S012 | proceedings of the DOE chemical energy storage and hydrogen energy systems contracts review . . . | J017 |
| an interactive lake survey program | S013 | final report for Phase I—coal desulfurization by low temperature chlorinolysis . | K004 |
| DSN command system Mark III-78 . | S038 | a market survey of geothermal wellhead power generation systems final report . | L024 |
| energy consumption program—a computer model simulating energy loads in buildings | S079 | the engineering analysis of solar radiation | R013 |
| standardized development of computer software part II standards | S085 | hydrogen from the solar photolysis of water | R065 |
| statistical error analysis using the UDUT covariance factorization | T003 | overview of novel photovoltaic conversion techniques at high intensity levels | S083 |
| the robot's eyes stereo vision system for automated scene analysis | T018 | thermal optical surface properties and high-temperature solar energy conversion | W019 |
| Computer Systems | W026 | progress towards high efficiency polycrystalline thin-film GaAs AMOS solar cells | Y006 |
| fully automated urban traffic system . | D029 | development of low-cost silicon crystal growth techniques for terrestrial photovoltaic solar energy conversion . . | Z007 |
| UNIBUS monitor for PDP 11 | D031 | Cost Effectiveness | |
| network operations control center block III modifications | G010 | radio-frequency carrier arraying for high-rate telemetry reception | B064 |
| GCF HSD error control | H053 | evaluation of the DSN software methodology | I003 |
| Jet Propulsion Laboratory 1976–1977 annual report | J021 | a life-cycle description of underground coal mining | L012 |
| CCM implementation status | M008 | | |
| fault-tolerant building-block computer study | R023 | | |

| Subject | Entry | Subject | Entry |
|--|-------|---|-------|
| evaluation of the developing DSN life-cycle cost standard practice. | M034 | synthetic aperture radar imagery of the AIDJEX triangle | B069 |
| life cycle costing with a discount rate | P022 | a study of alteration associated with uranium occurrences in sandstone and its detection by remote sensing methods | C036 |
| Crystallography | | application of multispectral radar and LANDSAT imagery to geologic mapping in Death Valley | D001 |
| a multiple pulse zero crossing NMR technique, and its application to ¹⁹ F chemical shift measurements in solids | B076 | radar observations of a volcanic terrain Askja Caldera, Iceland. | E024 |
| on the crystal phases of (DEPE) (TCNQ) ₄ | C035 | a synoptic description of coal basins via image processing | F010 |
| structure of deformed silicon and implications for low cost solar cells | M009 | applications of aerospace technology to petroleum extraction and reservoir engineering | J006 |
| electrical properties of (DEPE) (TCNQ) ₄ | S057 | proceedings of the conference on coal use for California | J025 |
| development of low-cost silicon crystal growth techniques for terrestrial photovoltaic solar energy conversion | Z007 | a life-cycle description of underground coal mining | L012 |
| Cybernetics | | a closed network queue model of underground coal mining production, failure, and repair | L047 |
| on the inherent intractability of certain coding problems.. .. . | B031 | an interactive lake survey program | S038 |
| an application of the square root information filter to large-scale linear interconnected systems | B051 | Economics | |
| the role of robots and automation in space extraterrestrial intelligence an observational approach | H015 | process heat in California applications and potential for solar energy in the industrial, agricultural and commercial sectors | B006 |
| a model for sensorimotor control and learning | M069 | the role of interest and inflation rates in life-cycle cost analysis | E005 |
| the robot's eyes stereo vision system for automated scene analysis | R002 | a Southern California Gas Company Project SAGE report—public policy issues | H036 |
| | W026 | proceedings of small power systems solar electric workshop, held at Aspen, Colorado, October 10–12, 1977 executive summary | J019 |
| Documentation and Information Technology | | proceedings of small power systems solar electric workshop, held at Aspen, Colorado, October 10–12, 1977 invited papers | J020 |
| standard practices for the implementation of computer software | J023 | proceedings of the conference on coal use for California | J025 |
| a public-key cryptosystem based on algebraic coding theory | M026 | development of a unified criterion for solar collector selection | L005 |
| some data relationships among diverse areas of the DSN and JPL | S048 | a life-cycle description of underground coal mining | L012 |
| standardized development of computer software part II. standards | T003 | evaluation of the developing DSN life-cycle cost standard practice | M034 |
| elements of an image-based information system | Z005 | life cycle costing with a discount rate | P022 |
| Dynamic Oceanography | | economic evaluation of DSS 13 unattended operations demonstration | R020 |
| Seasat-A opens new phase in Earth observations . | C053 | a life cycle cost economics model for automation projects with uniformly varying operating costs | R021 |
| radar imaging of the ocean surface . .. | E010 | | |
| focusing effects in the synthetic aperture radar imaging of ocean waves | J008 | | |
| Earth Resources | | | |
| evaluation of Landsat MSS vs TM simulated data for distinguishing "hydrothermal alteration" | A001 | | |
| computer image processing—geologic applications | A002 | | |
| proceedings of the alternate energy systems seminar | A014 | | |

| Subject | Entry | Subject | Entry |
|---|--------|---|--------|
| an effective procurement and financial management reporting system | R056 | low-noise receivers S-band parametric upconverter development | P012 |
| a Southern California Gas Company Project SAGE report—selected U S building industry processes and characteristics | . S009 | potential end-to-end imaging information rate advantages of various alternative communication systems | R039 |
| a Southern California Gas Company Project SAGE report—utilization requirements | S010 | the effects of copper and titanium on silicon solar cells | S001 |
| historical evidence of importance to the industrialization of flat-plate silicon photovoltaic systems executive summary | . S045 | some failure modes and analysis techniques for Terrestrial solar cell modules. | S022 |
| historical evidence of importance to the industrialization of flat-plate silicon photovoltaic systems | S046 | results of the 1974 through 1977 NASA/JPL balloon flight solar cell calibration program | . S023 |
| Electronics and Electrical Engineering | | the false lock performance of Costas loops with hard-limited in-phase channel | S027 |
| analysis of hydrogen maser frequency drift due to possible drifts in load VSWR and phase angle of reflection coefficient | . B017 | on the calculation of squaring loss in Costas loops with arbitrary arm filters | S028 |
| on the crystal phases of (DEPE) (TCNQ) ₄ | .C035 | tracking performance of Costas loops with hard-limited in-phase channel | S029 |
| effect of copper impurity on polycrystalline silicon solar cells | D007 | electrical properties of (DEPE) (TCNQ) ₄ | S057 |
| microwave power transmitting phased array antenna research project summary report | D025 | ionizing radiation effects on SBP9900 microprocessor | S071 |
| the beamed power microwave transmitting antenna | D026 | SEM analysis of ionizing radiation effects in linear integrated circuits | S072 |
| SPS microwave subsystem potential impacts and benefits | D027 | three-channel integrating analog-to-digital converter | S077 |
| DSN ground communications facility | E027 | overview of novel photovoltaic conversion techniques at high intensity levels | S083 |
| a microwave pressure sounder | F025 | the tone generator and phase calibration in VLBI measurements | T012 |
| the ISEE-C vector helium magnetometer | F028 | S-band maser phase delay stability tests | U004 |
| absolute flux density calibrations of radio sources 2.3 GHz | F029 | a note on the assumption of quasiequilibrium in semiconductor junction devices | V022 |
| preliminary studies of electromagnetic sounding of cometary nuclei | G001 | a simple theory of back surface field (BSF) solar cells | V023 |
| synthesis of a laterally displaced cluster feed for a reflector antenna with application to multiple beams and contoured patterns | G002 | quantum statistical theory of semiconductor junctions in thermal equilibrium | V024 |
| wide area detection system conceptual design study | H031 | recombination-generation currents in degenerate semiconductors | V025 |
| broad perspectives in radar for ocean measurements | J007 | analysis of the interaction of an electron beam with a solar cell—I | V026 |
| on improved ranging | L016 | analysis of the interaction of an electron beam with a solar cell—II | V027 |
| tracking loop and modulation format considerations for high rate telemetry | L029 | FPLA mechanization of arithmetic elements to produce A + B or to pass A only | W006 |
| stable low noise voltage source | L056 | differential encoding for multiple amplitude and phase shift keying systems | W011 |
| CCM implementation status | M008 | a bandwidth compressive modulation system using multi-amplitude minimum shift keying (MAMSK) | W012 |
| codes arising from non-abelian group algebras | M048 | a prototype DSN X-S band feed DSS 13 application status (second report) | W035 |
| a method for measuring group time delay through a feed horn | O009 | | |
| updated Z-corrections for 64-m DSS ground station delay calibrations | O012 | | |

| Subject | Entry | Subject | Entry |
|---|----------------------|---|-------|
| optimal sampling and quantization of synthetic aperture radar signals | W048 | low-cost silicon solar array (LSSA) project quarterly report 5, for the period April 1977-June 1977 | J018 |
| a Schottky-barrier solar cell on sliced polycrystalline GaAs | Y005 | proceedings of small power systems solar electric workshop, held at Aspen, Colorado, October 10-12, 1977 executive summary | J019 |
| progress towards high efficiency polycrystalline thin-film GaAs AMOS solar cells | Y006 | proceedings of small power systems solar electric workshop, held at Aspen, Colorado, October 10-12, 1977 invited papers | J020 |
| a preliminary model for high-power waveguide arcing and arc protection | Y007 | Jet Propulsion Laboratory 1976-1977 annual report | J021 |
| development of low-cost silicon crystal growth techniques for terrestrial photovoltaic solar energy conversion | Z007 | proceedings of the conference on coal use for California | J025 |
| Energy (General) | | low-cost solar array (LSA) project quarterly report 6, for the period July 1977-September 1977 | J028 |
| proceedings of the alternate energy systems seminar | A014 | low-cost solar array (LSA) project quarterly report 7, for the period October 1977-December 1977 | J031 |
| process heat in California applications and potential for solar energy in the industrial, agricultural and commercial sectors | B006 B010 C017 | storage, transmission and distribution of hydrogen. | K011 |
| the Goldstone Energy Project final report | D006 | weight propagation and equivalent horsepower for alternate-engined cars | K025 |
| multi-wire slurry wafering demonstrations | D007 | a life-cycle description of underground coal mining | L012 |
| effect of multiblade slurry saw induced damage on silicon solar cells | D010 | a market survey of geothermal wellhead power generation systems final report | L024 |
| effect of copper impurity on polycrystalline silicon solar cells | D025 | utilization of waste heat in trucks for increased fuel economy | L027 |
| potential for cogeneration of heat and electricity in California industry-Phase I final report | D026 | waste heat recovery in truck engines | L028 |
| microwave power transmitting phased array antenna research project summary report | D027 | a closed network queue model of underground coal mining production, failure, and repair | L047 |
| the beamed power microwave transmitting antenna | E017 | structure of deformed silicon and implications for low cost solar cells | M009 |
| SPS microwave subsystem potential impacts and benefits | F032 | compatibility studies of various refractory materials in contact with molten silicon | O001 |
| continuous extrusion of coal | G038 | the engineering analysis of solar radiation calibration standards and field instruments for the precision measurement of insolation | R013 |
| solar energy for process heat design/cost studies of four industrial retrofit applications | H024 | hydrogen from the solar photolysis of water | R014 |
| environmental testing of flat plate solar cell modules | H036 | the effects of copper and titanium on silicon solar cells | R065 |
| a probabilistic model of insolation for the Mojave desert area | H038 | a Southern California Gas Company Project SAGE report-selected U S building industry processes and characteristics | S001 |
| a Southern California Gas Company Project SAGE report-public policy issues | H039 | a Southern California Gas Company Project SAGE report-utilization requirements | S009 |
| the diffusion of the use of new energy technology as a context for an overview of solar energy technologies | H042 | some failure modes and analysis techniques for Terrestrial solar cell modules | S010 |
| an overview of U S energy options supply-and-demand-side history and prospects | J006 | overview of novel photovoltaic conversion techniques at high intensity levels | S022 |
| siting issues for solar thermal power plants with small community applications | | | S083 |
| applications of aerospace technology to petroleum extraction and reservoir engineering | | | |

| Subject | Entry | Subject | Entry |
|---|-------|---|-------|
| analysis of the interaction of an electron beam with a solar cell—I | V026 | the engineering analysis of solar radiation | R013 |
| analysis of the interaction of an electron beam with a solar cell—II | V027 | calibration standards and field instruments for the precision measurement of insolation | R014 |
| progress towards high efficiency polycrystalline thin-film GaAs AMOS solar cells | Y006 | hydrogen from the solar photolysis of water | R065 |
| Energy Production | | new method of feeding coal continuous extrusion of fully plastic coal | R066 |
| proceedings of the alternate energy systems seminar | A014 | a Southern California Gas Company Project SAGE report—selected US building industry processes and characteristics | S009 |
| analysis of heat losses and casing temperatures of steam injection wells with annular coolant water flow | B002 | a Southern California Gas Company Project SAGE report—utilization requirements | S010 |
| process heat in California applications and potential for solar energy in the industrial, agricultural and commercial sectors | B006 | thermal optical surface properties and high-temperature solar energy conversion | W019 |
| the Goldstone Energy Project final report | B010 | development of low-cost silicon crystal growth techniques for terrestrial photovoltaic solar energy conversion | Z007 |
| performance of solar-powered vapor-jet refrigeration systems with selected working fluids | C010 | Energy Storage | |
| multi-wire slurry wafering demonstrations | C017 | the Goldstone Energy Project final report | B010 |
| finite-element solutions for geothermal systems | C019 | proceedings of the DOE chemical energy storage and hydrogen energy systems contracts review | J017 |
| potential for cogeneration of heat and electricity in California industry—Phase I final report | D010 | storage, transmission and distribution of hydrogen | K011 |
| environmental testing of flat plate solar cell modules | G038 | Engineering (General) | |
| a Southern California Gas Company Project SAGE report—public policy issues | H036 | pressure pulsations on a flat plate normal to an underexpanded supersonic jet | B001 |
| the diffusion of the use of new energy technology as a context for an overview of solar energy technologies | H038 | a survey of electric and hybrid vehicle simulation programs final report | B047 |
| coal desulfurization by low-temperature chlorinolysis | H049 | a highly accurate method for the determination of mass and center of mass of a spacecraft | C022 |
| applications of aerospace technology to petroleum extraction and reservoir engineering | J006 | preliminary analysis of the impact of power cycling on CTA-21 equipment reliability | C034 |
| proceedings of the DOE chemical energy storage and hydrogen energy systems contracts review | J017 | high-power, ultralow-mass solar arrays FY-77 solar arrays technology readiness assessment report (Volume I) | C041 |
| proceedings of small power systems solar electric workshop, held at Aspen, Colorado, October 10–12, 1977: executive summary | J019 | high-power, ultralow-mass solar arrays FY-77 solar arrays technology readiness assessment report (Volume II) | C042 |
| proceedings of small power systems solar electric workshop, held at Aspen, Colorado, October 10–12, 1977: invited papers | J020 | effect of multiblade slurry saw induced damage on silicon solar cells | D006 |
| final report for Phase I—coal desulfurization by low temperature chlorinolysis | K004 | the beamed power microwave transmitting antenna | D026 |
| development of a unified criterion for solar collector selection | L005 | SPS microwave subsystem potential impacts and benefits | D027 |
| a market survey of geothermal wellhead power generation systems final report | L024 | fully automated urban traffic system | D029 |
| | | automotive technology status and projections executive summary | D032 |
| | | automotive technology status and projections assessment report | D033 |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| automotive fuel economy and emissions program | D034 | Environment Pollution | |
| DSN ground communications facility | E027 | analysis of DOT near-term transportation research, development, and demonstration activities | B004 |
| synthesis of a laterally displaced cluster feed for a reflector antenna with application to multiple beams and contoured patterns | G002 | hydrogen enrichment for low-emission jet combustion | C030 |
| evaluation of FIDC system final report | H006 | the beamed power microwave transmitting antenna | D026 |
| the diffusion of the use of new energy technology as a context for an overview of solar energy technologies | H038 | upper atmosphere research satellite program final report of the science working group | J024 |
| an overview of U S energy options supply-and-demand-side history and prospects | H039 | proceedings of the conference on coal use for California | J025 |
| development support—DSS 13 S-X unattended systems development | J001 | rate constant for the reaction $\text{ClO} + \text{NO} \rightarrow \text{Cl} + \text{NO}_2$ | L031 |
| low-cost silicon solar array (LSSA) project quarterly report 5, for the period April 1977–June 1977 | J018 | atmospheric monitoring using heterodyne detection techniques | M042 |
| JPL basic research review | J027 | the airborne laser absorption spectrometer | S020 |
| low-cost solar array (LSA) project quarterly report 6, for the period July 1977–September 1977 | J028 | an assessment of an F_2 or N_2O_4 atmospheric injection from an aborted space shuttle mission | W010 |
| low-cost solar array (LSA) project quarterly report 7, for the period October 1977–December 1977 | J031 | Environmental Biology | |
| final report for Phase I—coal desulfurization by low temperature chlorinolysis | K004 | thermal resistance of naturally occurring airborne bacterial spores | P032 |
| weight propagation and equivalent horsepower for alternate-engined cars | K025 | Fluid Mechanics and Heat Transfer | |
| development of a unified criterion for solar collector selection | L005 | pressure pulsations on a flat plate normal to an underexpanded supersonic jet | B001 |
| structure of deformed silicon and implications for low cost solar cells | M009 | analysis of heat losses and casing temperatures of steam injection wells with annular coolant water flow | B002 |
| DSS 13 antenna subsystem automation | P013 | an investigation of the side force that is sometimes observed in rocket start-up | B058 |
| life cycle costing with a discount rate | P022 | performance of solar-powered vapor-jet refrigeration systems with selected working fluids | C010 |
| the false lock performance of Costas loops with hard-limited in-phase channel | S027 | finite-element solutions for geothermal systems | C019 |
| on the calculation of squaring loss in Costas loops with arbitrary arm filters | S028 | enclosure fire hazard analysis using relative energy release criteria | C044 |
| tracking performance of Costas loops with hard-limited in-phase channel | S029 | solar energy for process heat design/cost studies of four industrial retrofit applications | F032 |
| DSN monitor and control system, Mark III-78 | S080 | analysis and tests of a wide angle radiometer viewlimiter | K013 |
| overview of novel photovoltaic conversion techniques at high intensity levels | S083 | application of the relative energy release criteria to enclosure fire testing | R052 |
| assessment of free-living nitrogen fixing microorganisms for commercial nitrogen fixation | S084 | energy consumption program—a computer model simulating energy loads in buildings | S085 |
| differential encoding for multiple amplitude and phase shift keying systems | W011 | theoretical analysis of heat flow in horizontal ribbon growth from a melt | Z006 |
| a bandwidth compressive modulation system using multi-amplitude minimum shift keying (MAMSK) | W012 | Geodesy | |
| | | microwave radiometer measurement of water vapor path delay data reduction techniques | C029 |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| Geology and Mineralogy | | Jupiter's atmosphere observations and interpretation of the microwave spectrum near 1.25-cm wavelength | K022 |
| computer image processing—geologic applications | A002 | rate constant for the reaction $\text{ClO} + \text{NO} \rightarrow \text{Cl} + \text{NO}_2$ | L031 |
| crack extension from flaws in a brittle material subjected to compression | A005 | processing the Viking lander camera data | L032 |
| final report of the ad hoc Mars airplane science working group | J029 | Viking 1975 Mars lander interactive computerized video stereophotogrammetry | L035 |
| Venus geologic analysis of radar images | S004 | UV absorption cross sections of H_2O_2 | L037 |
| Geophysics | | rate constant for the reaction of atomic chlorine with methane | L038 |
| crack extension from flaws in a brittle material subjected to compression | A005 | on the determination and investigation of the terrestrial ionospheric refractive indices using GEOS-3/ATS-6 satellite-to-satellite tracking data | L044 |
| an improved lunar moment of inertia determination a proposed strategy | A015 | effect of a changing G on the moment of inertia of the earth | L059 |
| the gravitational wave detection experiment description and anticipated requirements | B039 | on the accelerations of the Moon and Sun, the constant of gravitation, and the origin of mountains | L060 |
| Mars topography harmonics and geophysical implications | B054 | modification of fresh crater landforms evidence from the moon and mercury | M005 |
| computer processing of SAR L-band imagery | B070 | tropospheric ozone distributions measured with an airborne laser absorption spectrometer | M041 |
| the mass of Phobos from Viking flybys | C025 | atmospheric monitoring using heterodyne detection techniques | M042 |
| application of multispectral radar and LANDSAT imagery to geologic mapping in Death Valley | D001 | VLBI-laser intercomparison project | M068 |
| Viking imaging of Phobos and Deimos an overview of the primary mission | D044 | plasma fluctuations in the solar wind | N008 |
| barotropic instability in the upper atmosphere of Venus | E016 | IPL processing of the Viking orbiter images of Mars | R058 |
| Mars regolith adsorption and the relative concentrations of atmospheric rare gases | F001 | Venus geologic analysis of radar images | S004 |
| Mars the role of the regolith in determining atmospheric pressure and the atmosphere's response to insolation changes | F002 | observations of the interplanetary sector structure up to heliographic latitudes of 16° | S041 |
| Mars water vapor observations from the Viking orbiters | F006 | Pioneer 11 | S050 |
| the isostatic state of the lunar apennines and regional surroundings | F013 | the missions of the Viking orbiters | T012 |
| Viking radio occultation measurements of the Martian atmosphere and topography primary mission coverage | F023 | the tone generator and phase calibration in VLBI measurements | T020 |
| VLBI/laser intercomparison project session 2 | F024 | Viking orbiter observations of atmospheric opacity during July–November 1976 | T021 |
| analytical inversions in remote sensing of particle size distributions 1 multispectral extinctions in the anomalous diffraction approximation | F033 | Viking orbiter photometric observations of the Mars phase function July through November 1976 | U002 |
| evidence for the depletion of ammonia in the Uranus atmosphere | G040 | planetary benchmarks | V013 |
| the rotational spectrum and molecular parameters of ClO in the $v = 0$ and $v = 1$ states | K002 | Viking observations of Phobos and Deimos preliminary results | W036 |
| absolute rate and temperature dependence of the reaction between chlorine (2P) atoms and methane | K016 | accurate solar "constant" determinations by cavity pyrheliometers | W039 |
| | | dust storms Great Plains, Africa, and Mars | Z010 |
| | | solar heating of the Martian dusty atmosphere | |

| Subject | Entry | Subject | Entry |
|--|-------|--|-------|
| Geosciences and Oceanography (General) | | preliminary analysis of the impact of power cycling on CTA-21 equipment reliability | C034 |
| evaluation of Landsat MSS vs TM simulated data for distinguishing "hydrothermal alteration". | A001 | VLBI/laser intercomparison project session 2 | F024 |
| crack extension from flaws in a brittle material subjected to compression | A005 | Viking extended mission support | C016 |
| synthetic aperture radar imagery of the AIDJEX triangle | B069 | | C018 |
| computer processing of SAR L-band imagery | B070 | Helios mission support | H045 |
| application of multispectral radar and LANDSAT imagery to geologic mapping in Death Valley | D001 | dual-frequency feed cone assemblies for 34-meter antennas | H046 |
| radar imaging of the ocean surface. | E010 | development support—DSS 13 S-X unattended systems development | C027 |
| radar observations of a volcanic terrain Askja Caldera, Iceland. | E024 | Pioneer mission support | J001 |
| VLBI/laser intercomparison project session 2 | F024 | NASTRAN analysis of a wheel-rail loading on its foundation | J042 |
| a probabilistic model of insolation for the Mojave desert area | H024 | structural design of a 64-meter low-cost antenna | K007 |
| broad perspectives in radar for ocean measurements, | J007 | on improved ranging | K009 |
| focusing effects in the synthetic aperture radar imaging of ocean waves | J008 | compilation of wind tunnel coefficients for parabolic reflectors | L016 |
| estimates of precession and polar motion errors from planetary encounter station location solutions | P005 | LAASP 100-m antenna wind performance studies | L033 |
| temperate zone sporadic-E maps ($f_oE_s > 7$ MHz) | S043 | DSN system performance test software | L034 |
| detection and interpretation of ocean roughness variations across the gulf stream inferred from radar cross section observations | W017 | a public-key cryptosystem based on algebraic coding theory | M014 |
| on the suitability of Viking differenced range to the determination of relative Z-distance | W038 | analysis of a suspension system for a wheel rolling on a flat track | M026 |
| Ground Support Systems and Facilities (Space) | | lateral forces induced by a misaligned roller | M032 |
| the DSS radio science subsystem—real-time bandwidth reduction and wideband recording of radio science data | B036 | a tutorial introduction to very long baseline interferometry (VLBI) using bandwidth synthesis | M033 |
| the gravitational wave detection experiment description and anticipated requirements | B039 | JPL 2 ²⁰ channel 300 MHz bandwidth digital spectrum analyzer | M058 |
| the DSS radio science subsystem—data handling of very long baseline interferometry (VLBI) data | B040 | Voyager support | M061 |
| DSN radio science system, Mark III-78 | B041 | the DSN VLBI system, Mark I-79 | M062 |
| radio science requirements and the end-to-end ranging system. | B042 | a method for measuring group time delay through a feed horn | M067 |
| parametric modeling of low-frequency water-vapor-induced tropospheric path length fluctuations | B043 | updated Z-corrections for 64-m DSS ground station delay calibrations | O009 |
| radio-frequency carrier arraying for high-rate telemetry reception | B064 | hydrogen maser frequency standard computer model for automatic cavity tuning servo simulations | O012 |
| a demonstration of differenced dual-station one-way doppler conducted with Pioneer 11 | C014 | economic evaluation of DSS 13 unattended operations demonstration | P023 |
| | | network functions and facilities | R020 |
| | | Voyager near simultaneous ranging transfers | R027 |
| | | | R028 |
| | | | R029 |
| | | | R030 |
| | | | R031 |
| | | | R032 |
| | | | S060 |

| Subject | Entry | Subject | Entry |
|---|-------|---|-------|
| DSN "load and go" pre-track preparation for Voyager support | T009 | on the inherent intractability of certain coding problems | B031 |
| DSN 100-meter X- and S-band microwave antenna design and performance | W033 | an application of the square root information filter to large-scale linear interconnected systems | B051 |
| a prototype DSN X-S band feed DSS 13 first application status | W034 | applications of modern estimation techniques to aircraft navigation | B053 |
| frequency selection and calibration of a water vapor radiometer | W050 | a reformulation of the Linear-Quadratic-Gaussian stochastic control problem for application to low thrust navigation analysis | J003 |
| Ground Transportation Equipment | | application of Kalman filtering to spacecraft range residual prediction | M001 |
| evaluation of FIDC system final report | H006 | codes arising from non-abelian group algebras | M048 |
| weight propagation and equivalent horsepower for alternate-engined cars | K025 | linear stochastic control using the UDU^T matrix factorization | T016 |
| waste heat recovery in truck engines | L028 | | |
| Helios Project | | Instrumentation and Photography | |
| ground tracking system phase fluctuation spectra | B033 | Venus in motion | A019 |
| Helios mission support | G025 | application of CCD technology to produce imagery from radar data | A021 |
| | G026 | infrared astronomical satellite | A026 |
| | G027 | future of synthetic aperture radar | B005 |
| | G028 | intensity and pressure shift of the H_2 (4,0) $S(1)$ quadrupole line | B029 |
| | G029 | Mars topography harmonics and geophysical implications | B054 |
| radial dependence of solar wind properties deduced from Helios 1/2 and Pioneer 10/11 radio scattering observations | G030 | a white-light amplitude interferometer with 180-degree rotational shear | B062 |
| | W044 | synthetic aperture radar imagery of the AIDJEX triangle | B069 |
| History, Law, and Political Science | | computer processing of SAR L-band imagery | B070 |
| a Southern California Gas Company Project SAGE report—public policy issues | H036 | new technique for single-scan T_1 measurements using solid echoes | B077 |
| a Southern California Gas Company Project SAGE report—selected US building industry processes and characteristics | S009 | algorithms for isolating worst case systematic data errors | C052 |
| a Southern California Gas Company Project SAGE report—utilization requirements | S010 | Viking imaging of Phobos and Deimos an overview of the primary mission | D044 |
| Human-System Technology | | Phobos transit of Mars as viewed by the Viking cameras | D046 |
| standardized development of computer software part II standards | T003 | spacecraft imaging of Phobos and Deimos | D048 |
| Hydrology and Limnology | | radar imaging of the ocean surface | E010 |
| an interactive lake survey program | S038 | radar observations of a volcanic terrain Askja Caldera, Iceland | E024 |
| Information Theory | | Mars water vapor observations from the Viking orbiters | F006 |
| stochastic processes, estimation theory, and image enhancement | A022 | Viking radio occultation measurements of the Martian atmosphere and topography primary mission coverage | F023 |
| a probabilistic version of Sperner's Theorem, with applications to the problem of retrieving information from a data base | B015 | a microwave pressure sounder | F025 |
| soft decision decoding of block codes | B016 | new concepts for Mercury orbiter missions | F031 |
| on the fundamental structure of Galois switching functions | B025 | fiber optic rotation sensor (FORS) signal detection and processing | G032 |

| Subject | Entry | Subject | Entry |
|--|-------|--|-------|
| Viking image processing | G034 | Venus cloud structure and water vapor abundance from Mariner 10 observations | T007 |
| a distributed microprocessor system for topographic imaging of the ocean floor | H010 | Viking orbiter observations of atmospheric opacity during July–November 1976 | T020 |
| focusing effects in the synthetic aperture radar imaging of ocean waves | J008 | Viking orbiter photometric observations of the Mars phase function July through November 1976 | T021 |
| lunar spectral units a northern hemispheric mosaic | J036 | Viking first encounter of Phobos preliminary results | T022 |
| the rotational spectrum and molecular parameters of ClO in the $v = 0$ and $v = 1$ states | K002 | visual and infrared photometry of asteroids | V007 |
| photomask and pattern programming manual | K019 | Viking observations of Phobos and Deimos preliminary results | V013 |
| inflight performance of the Viking visual imaging subsystem | K020 | detection and interpretation of ocean roughness variations across the gulf stream inferred from radar cross section observations | W017 |
| Voyager mission description | K027 | the robot's eyes stereo vision system for automated scene analysis | W026 |
| identification of water frost on Callisto | L019 | accurate solar "constant" determinations by cavity pyrheliometers | W036 |
| processing the Viking lander camera data | L032 | dust storms Great Plains, Africa, and Mars | W039 |
| Viking 1975 Mars lander interactive computerized video stereophotogrammetry | L035 | measurements of the solar wind using spacecraft radio scattering observations | W045 |
| a search for the reported 400-keV γ -ray line from crab nebula | L041 | a system for extracting three-dimensional measurements from a stereo pair of TV cameras | Y002 |
| bandwidth compression of synthetic aperture radar imagery by quantization of raw radar data | L042 | | |
| enhancement of the jets in NGC 1097 | L052 | | |
| absorption strength of the perturbed ν_4 band of CH_3Cl | M012 | Jet and Gas Turbine Engines | |
| images of Io's sodium cloud | M023 | pressure pulsations on a flat plate normal to an underexpanded supersonic jet | B001 |
| tropospheric ozone distributions measured with an airborne laser absorption spectrometer | M041 | hydrogen enrichment for low-emission jet combustion | C030 |
| atmospheric monitoring using heterodyne detection techniques | M042 | | |
| thorium concentrations in the lunar surface I regional values and crustal content | M044 | Laboratories, Test Facilities, and Test Equipment | |
| postperihelion interference filter photometry of the "annual" comet P/Encke | N009 | storage of solid propellants in a dry environment | U001 |
| the composition of Phobos evidence for carbonaceous chondrite surface from spectral analysis | P002 | | |
| multicolor observations of Phobos with the Viking lander cameras evidence for a carbonaceous chondritic composition | P019 | Lasers and Masers | |
| calibration standards and field instruments for the precision measurement of insolation | R014 | analysis of hydrogen maser frequency drift due to possible drifts in load VSWR and phase angle of reflection coefficient | B017 |
| IPL processing of the Viking orbiter images of Mars | R058 | long-duration high-efficiency operation of a continuously pulsed copper laser utilizing copper bromide as a lasant | C016 |
| an interactive lake survey program | S038 | bandstrength determination of the fundamental vibration-rotation spectrum of ClO | M010 |
| the missions of the Viking orbiters | S050 | tropospheric ozone distributions measured with an airborne laser absorption spectrometer | M041 |
| photoacoustic spectroscopy of organometallic compounds with applications in the fields of quasi-one-dimensional conductors and catalysis | S055 | atmospheric monitoring using heterodyne detection techniques | M042 |
| | | VLBI-laser intercomparison project | M068 |
| | | scaling a double-pulsed copper chloride laser to 10 mJ | N005 |

| Subject | Entry | Subject | Entry |
|---|-------|---|-------|
| a continuously pulsed copper halide laser with a cable-capacitor Blumlein discharge circuit. | N006 | high-power, ultralow-mass solar arrays FY-77 solar arrays technology readiness assessment report (Volume II) . | C042 |
| low-noise receivers S-band parametric upconverter development | P012 | Viking imaging of Phobos and Deimos Phobos transit of Mars as viewed by the Viking cameras | D044 |
| hydrogen maser frequency standard computer model for automatic cavity tuning servo simulations . . | P023 | Deimos Encounter by Viking preliminary imaging results | D046 |
| the airborne laser absorption spectrometer a new instrument for remote measurement of atmospheric trace gases | S020 | spacecraft imaging of Phobos and Deimos barotropic instability in the upper atmosphere of venus | D047 |
| space power systems technology enablement study | S047 | experimental determination of Mercury's mass and oblateness | D048 |
| electron-impact cross sections for Cu atoms | T027 | Mars regolith adsorption and the relative concentrations of atmospheric rare gases | E016 |
| S-band maser phase delay stability tests | U004 | Mars the role of the regolith in determining atmospheric pressure and the atmosphere's response to insolation changes | E023 |
| effect of dissociation pulse circuit inductance on the CuCl laser | V010 | Mars water vapor observations from the Viking orbiters | F001 |
| Launch Vehicles and Space Vehicles | | the isostatic state of the lunar apennines and regional surroundings | F002 |
| summary of Voyager design and flight loads | C018 | Viking radio occultation measurements of the Martian atmosphere and topography primary mission coverage | F006 |
| launch vehicle payload interface response | C020 | the ISEE-C vector helium magnetometer | F013 |
| Seasat-A opens new phase in Earth observations | C053 | new concepts for Mercury orbiter missions | F023 |
| orbit trim maneuver design and implementation for the 1975 Mars Viking mission | H035 | Viking image processing | F028 |
| orbiting deep space relay station, a study report | H054 | evidence for the depletion of ammonia in the Uranus atmosphere | F031 |
| infrared astronomical satellite | M036 | orbit trim maneuver design and implementation for the 1975 Mars Viking mission | G034 |
| Voyager support. | M062 | Viking extended mission support | G040 |
| an entree for large space antennas | P025 | elements of solar sail navigation with application to a Halley's comet rendezvous | H035 |
| space power systems technology enablement study | S047 | interplanetary approach optical navigation with applications | H045 |
| an assessment of an F ₂ or N ₂ O ₄ atmospheric injection from an aborted space shuttle mission | .W010 | Jet Propulsion Laboratory 1976-1977 annual report | J005 |
| Lunar and Planetary Exploration (Advanced) | | dynamics of Earth and planetary atmospheres a brief assessment of our present understanding | J016 |
| an improved lunar moment of inertia determination a proposed strategy | A015 | final report of the ad hoc Mars airplane science working group | J021 |
| tests of general relativity using astrometric and radio metric observations of the planets | A017 | the Galilean satellites of Jupiter four worlds | J022 |
| Venus in motion | A019 | lunar spectral units a northern hemispheric mosaic | J029 |
| missions to comets an options review | A024 | a TiO ₂ abundance map for the northern maria | J032 |
| D/H & C/H ratios in Jupiter/CH ₃ D phase | B019 | inflight performance of the Viking visual imaging subsystem | J036 |
| Mars topography harmonics and geophysical implications | B054 | evidence of an increase in the microwave brightness temperature of Uranus | J037 |
| Δ VLBI spacecraft tracking system demonstration Part I design and planning | B066 | | K020 |
| sodium D-line emission from Io comparison of observed and theoretical line profiles | C005 | | K021 |
| the mass of Phobos from Viking flybys | C025 | | |
| high-power, ultralow-mass solar arrays FY-77 solar arrays technology readiness assessment report (Volume I) | C041 | | |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| Jupiter's atmosphere observations and interpretation of the microwave spectrum near 1.25-cm wavelength | | planetary benchmarks | U002 |
| Voyager mission description | K022 | visual and infrared photometry of asteroids | V007 |
| identification of water frost on Callisto | K027 | Viking observations of Phobos and Deimos preliminary results | V013 |
| processing the Viking lander camera data. | L019 | the puzzling moons of Mars | V017 |
| Viking 1975 Mars lander interactive computerized video stereophotogrammetry | L032 | dust storms Great Plains, Africa, and Mars | W039 |
| Galilean satellites analysis of photometric eclipses | L035 | solar heating of the Martian dusty atmosphere | Z010 |
| on the accelerations of the Moon and Sun, the constant of gravitation, and the origin of mountains | L036 | LANDSAT Project | |
| modification of fresh crater landforms evidence from the moon and mercury | L060 | application of multispectral radar and LANDSAT imagery to geologic mapping in Death Valley | D001 |
| soil maturity and planetary regoliths the Moon, Mercury, and the asteroids | M005 | Mariner Jupiter/Saturn 1977 Project | |
| asteroids and comparative planetology | M019 | implementation of automated fault isolation test programs for maximum likelihood convolutional decoder (MCD) maintenance | A012 |
| images of Io's sodium cloud | M022 | spacecraft subsystem checkout by minicomputer | A016 |
| thorium concentrations in the lunar surface I regional values and crustal content | M023 | Δ VLBI spacecraft tracking system demonstration Part I design and planning | B066 |
| on a correlation between surface remanent magnetism and chemistry for the lunar frontside and limbs | M044 | mission applications of the dual spacecraft tracking technique | C013 |
| postperihelion interference filter photometry of the "annual" comet P/Encke | M045 | a highly accurate method for the determination of mass and center of mass of a spacecraft | C022 |
| an overview of Viking navigation | N009 | implementation of the radio science subsystem in the DSN | K018 |
| the composition of Phobos evidence for carbonaceous chondrite surface from spectral analysis | O002 | Voyager mission description | K027 |
| multicolor observations of Phobos with the Viking lander cameras evidence for a carbonaceous chondritic composition | P002 | Voyager support | M062 |
| potential end-to-end imaging information rate advantages of various alternative communication systems | P019 | establishing a celestial VLBI reference frame—I searching for VLBI sources | P028 |
| equipotential doming in flooded circular basins on the Moon | R039 | Voyager near simultaneous ranging transfers | S060 |
| IPL processing of the Viking orbiter images of Mars | R055 | DSN "load and go" pre-track preparation for Voyager support | T009 |
| Venus geologic analysis of radar images | R058 | DSN test and training system, Mark III-77 | T015 |
| the missions of the Viking orbiters | S004 | tracking operations during the Voyager 2 launch phase | W001 |
| Venus cloud structure and water vapor abundance from Mariner 10 observations | S050 | on the suitability of Viking differenced range to the determination of relative Z-distance | W038 |
| Viking orbiter observations of atmospheric opacity during July–November 1976 | T007 | Mariner Venus/Mercury 1973 Project | |
| Viking orbiter photometric observations of the Mars phase function July through November 1976 | T020 | an interpretation of Mariner 10 helium (584 Å) and hydrogen (1216 Å) | |
| Viking first encounter of Phobos preliminary results | T021 | interplanetary emission observations | A009 |
| | T022 | Venus in motion | A019 |
| | | barotropic instability in the upper atmosphere of venus | E016 |
| | | experimental determination of Mercury's mass and oblateness | E023 |
| | | Venus cloud structure and water vapor abundance from Mariner 10 observations | T007 |

| Subject | Entry | Subject | Entry |
|--|-------|---|-------|
| Materials (General) | | on the fundamental structure of Galois switching functions | B025 |
| a statistical, micromechanical theory of the compressive strength of brittle materials . | A004 | on the inherent intractability of certain coding problems | B031 |
| crack extension from flaws in a brittle material subjected to compression | A005 | an application of the square root information filter to large-scale linear interconnected systems | B051 |
| enclosure fire hazard analysis using relative energy release criteria . | C044 | a highly accurate method for the determination of mass and center of mass of a spacecraft | C022 |
| effect of multiblade slurry saw induced damage on silicon solar cells | D006 | algorithms for isolating worst case systematic data errors . | C052 |
| effect of copper impurity on polycrystalline silicon solar cells . | D007 | wide area detection system conceptual design study .. | H031 |
| continuous extrusion of coal | E017 | a reformulation of the Linear-Quadratic-Gaussian stochastic control problem for application to low thrust navigation analysis | J003 |
| strain energy function of styrene butadiene rubber and the effect of temperature | G020 | proceedings: conference on the programming environment for development of numerical software . | J030 |
| low-cost silicon solar array (LSSA) project quarterly report 5, for the period April 1977-June 1977 .. | J018 | structural design of a 64-meter low-cost antenna | K009 |
| JPL basic research review | J027 | photomask and pattern programming manual | K019 |
| low-cost solar array (LSA) project quarterly report 6, for the period July 1977-September 1977 | J028 | a transform-pair relationship between incident and scattered fields from an arbitrary reflector | L054 |
| low-cost solar array (LSA) project quarterly report 7, for the period October 1977-December 1977 | J031 | application of Kalman filtering to spacecraft range residual prediction | M001 |
| structure of deformed silicon and implications for low cost solar cells | M009 | a public-key cryptosystem based on algebraic coding theory | M026 |
| development and evaluation of elastomeric materials for geothermal applications—annual report, October 1978–October 1977 | M066 | the Lovasz bound and some generalizations | M027 |
| compatibility studies of various refractory materials in contact with molten silicon. . . . | O001 | a property of Euclid's algorithm and an application to Pade approximation | M031 |
| application of the relative energy release criteria to enclosure fire testing .. | R052 | a game with n numbers | M047 |
| the effects of copper and titanium on silicon solar cells | S001 | necklaces, symmetries and self-reciprocal polynomials | M052 |
| some failure modes and analysis techniques for Terrestrial solar cell modules | S022 | JPL 2 ²⁰ channel 300 MHz bandwidth digital spectrum analyzer | M061 |
| determination of bulk diffusion lengths for angle-lapped semiconductor material via the scanning electron microscope—a theoretical analysis. | V021 | estimates of precession and polar motion errors from planetary encounter station location solutions. | P005 |
| progress towards high efficiency polycrystalline thin-film GaAs AMOS solar cells | Y006 | reconfigurable modular computer networks for spacecraft on-board processing | R024 |
| theoretical analysis of heat flow in horizontal ribbon growth from a melt.. | Z006 | a study of standard building blocks for the design of fault-tolerant distributed computer systems | R026 |
| Mathematical and Computer Sciences (General) | | RPV application of a globally adaptive rate controlled compressor . | R040 |
| a statistical, micromechanical theory of the compressive strength of brittle materials . . | A004 | an effective procurement and financial management reporting system | R056 |
| a probabilistic version of Sperner's Theorem, with applications to the problem of retrieving information from a data base . . . | B015 | the DSN standard real-time language | S012 |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| parallel compilation a design and its application to SIMULA 67 | S013 | upper atmosphere research satellite program final report of the science working group | J024 |
| linear stochastic control using the UDU^T matrix factorization. | T016 | final report of the ad hoc Mars airplane science working group | J029 |
| statistical error analysis using the UDU^T covariance factorization | T018 | tracking error of 100-m antenna due to wind gust | M016 |
| elements of an image-based information system | Z005 | tropospheric ozone distributions measured with an airborne laser absorption spectrometer | M041 |
| Mechanical Engineering | | temperate zone sporadic-E maps ($f_oE_s > 7$ MHz) | S043 |
| performance of solar-powered vapor-jet refrigeration systems with selected working fluids | C010 | accurate solar "constant" determinations by cavity pyrhelimeters | W036 |
| the Otto-engine-equivalent vehicle concept | D036 | dust storms Great Plains, Africa, and Mars | W039 |
| solar energy for process heat design/cost studies of four industrial retrofit applications | F032 | frequency selection and calibration of a water vapor radiometer. | W050 |
| parametric study of two planar high power flexible solar array concepts | G008 | Microbiology | |
| JPL energy consumption program (ECP) documentation a computer model simulating heating, cooling and energy loads in buildings | L004 | thermal resistance of naturally occurring airborne bacterial spores | P032 |
| tracking error of 100-m antenna due to wind gust | M016 | labeled cells. | R016 |
| analysis of a suspension system for a wheel rolling on a flat track | M032 | effect of ultrasonic irradiation on mammalian cells and chromosomes <i>in vitro</i> | R053 |
| lateral forces induced by a misaligned roller | M033 | Mining Engineering | |
| a model for sensorimotor control and learning | R002 | analysis of heat losses and casing temperatures of steam injection wells with annular coolant water flow | B002 |
| new method of feeding coal continuous extrusion of fully plastic coal | R066 | Missile Technology (General) | |
| energy consumption program—a computer model simulating energy loads in buildings | S085 | an investigation of the side force that is sometimes observed in rocket start-up | B058 |
| Metallurgy and Metallography | | Navigation and Guidance | |
| space power systems technology enablement study | S047 | elements of solar sail navigation with application to a Halley's comet rendezvous | J005 |
| Meteorology and Climatology | | hydrogen maser frequency standard computer model for automatic cavity tuning servo simulations | P023 |
| parametric modeling of low-frequency water-vapor-induced tropospheric path length fluctuations | B043 | Nuclear and High Energy Physics | |
| microwave radiometer measurement of water vapor path delay data reduction techniques | C029 | ionizing radiation effects on SBP9900 microprocessor | S071 |
| a microwave pressure sounder | F025 | SEM analysis of ionizing radiation effects in linear integrated circuits | S072 |
| examination of the DSN X-band weather specifications | G036 | Nuclear Science and Technology (General) | |
| a study of forecast error growth with a barotropic model of the atmosphere | H005 | ionizing radiation effects on SBP9900 microprocessor | S071 |
| a probabilistic model of insolation for the Mojave desert area | H024 | SEM analysis of ionizing radiation effects in linear integrated circuits | S072 |
| siting issues for solar thermal power plants with small community applications | H042 | Numerical Analysis | |
| dynamics of Earth and planetary atmospheres a brief assessment of our present understanding | J022 | on the fundamental structure of Galois switching functions | B025 |

| Subject | Entry | Subject | Entry |
|---|-------|---|-------|
| applications of modern estimation techniques to aircraft navigation | B053 | analysis and tests of a wide angle radiometer viewlimiter | K013 |
| algorithms for isolating worst case systematic data errors . | C052 | inflight performance of the Viking visual imaging subsystem | K020 |
| analytical inversions in remote sensing of particle size distributions 1 multispectral extinctions in the anomalous diffraction approximation . | F033 | UV absorption cross sections of H_2O_2 | L037 |
| fiber optic rotation sensor (FORS) signal detection and processing . | G032 | enhancement of the jets in NGC 1097. . . . | L052 |
| a reformulation of the Linear-Quadratic-Gaussian stochastic control problem for application to low thrust navigation analysis . | J003 | a transform-pair relationship between incident and scattered fields from an arbitrary reflector | L054 |
| proceedings conference on the programming environment for development of numerical software | J030 | bandstrength determination of the fundamental vibration-rotation spectrum of ClO | M010 |
| application of Kalman filtering to spacecraft range residual prediction | M001 | soil maturity and planetary regoliths the Moon, Mercury, and the asteroids .. | M019 |
| a property of Euclid's algorithm and an application to Pade approximation | M031 | photoacoustic spectroscopy of condensed matter . | S053 |
| a game with n numbers . | M047 | photoacoustic spectroscopy of organometallic compounds with applications in the fields of quasi-one-dimensional conductors and catalysis.. | S055 |
| codes arising from non-abelian group algebras . . | M048 | optical, spin-resonance, and magnetoresistance studies of (tetrathiatetracene) $_2$ (iodide) $_3$, the nature of the ground state | S056 |
| necklaces, symmetries and self-reciprocal polynomials | M052 | visual and infrared photometry of asteroids . | V007 |
| an empirical spectral bandwidth model for superior conjunction | R048 | thermal optical surface properties and high-temperature solar energy conversion | W019 |
| linear stochastic control using the UDU^T matrix factorization. | T016 | a system for extracting three-dimensional measurements from a stereo pair of TV cameras | Y002 |
| statistical error analysis using the UDU^T covariance factorization | T018 | solar heating of the Martian dusty atmosphere . | Z010 |
| a note on the assumption of quasiequilibrium in semiconductor junction devices . | V022 | Organic Chemistry | |
| Optical Detection | | coal desulfurization by low-temperature chlorinolysis.. . . . | H049 |
| planetary benchmarks . | U002 | variable fragmentation mass spectrometry using chemi-ionization | L011 |
| Optics | | Particle Physics | |
| the D/H and C/H ratios in Jupiter from the CH_3D phase . | B019 | cross sections for electron impact of N_2 . | C007 |
| a white-light amplitude interferometer with 180-degree rotational shear | B062 | electron scattering by metal vapors . | T024 |
| sodium D-line emission from Io comparison of observed and theoretical line profiles | C005 | Physical Chemistry | |
| analytical inversions in remote sensing of particle size distributions 1 multispectral extinctions in the anomalous diffraction approximation | F033 | intensity and pressure shift of the H_2 (4,0) S(1) quadrupole line . | B029 |
| fiber optic rotation sensor (FORS) signal detection and processing | G032 | a multiple pulse zero crossing NMR technique, and its application to ^{19}F chemical shift measurements in solids | B076 |
| Viking image processing | G034 | cross sections for electron impact excitation of the electronic states of N_2 | C007 |
| lunar spectral units a northern hemispheric mosaic | J036 | electron-impact excitation of the low-lying electronic states of HCN | C027 |
| | | analytical inversions in remote sensing of particle size distributions 1 multispectral extinctions in the anomalous diffraction approximation | F033 |

| Subject | Entry | Subject | Entry |
|---|-------|---|-------|
| the rotational spectrum and molecular parameters of ClO in the $v = 0$ and $v = 1$ states | K002 | a transform-pair relationship between incident and scattered fields from an arbitrary reflector | L054 |
| absolute rate and temperature dependence of the reaction between chlorine (2P) atoms and methane | K016 | absorption strength of the perturbed ν_4 band of CH_3Cl | M012 |
| variable fragmentation mass spectrometry using chemi-ionization | L011 | a tutorial introduction to very long baseline interferometry (VLBI) using bandwidth synthesis | M058 |
| rate constant for the reaction $\text{ClO} + \text{NO} \rightarrow \text{Cl} + \text{NO}_2$ | L031 | the DSN VLBI system, Mark I-79 | M067 |
| ultraviolet absorption cross sections of hydrogen peroxide | L037 | influence of internally generated pure tones on the broadband noise radiated from a jet | P004 |
| rate constant for the reaction of atomic chlorine with methane | L038 | photoacoustic spectroscopy of condensed matter elastic scattering of intermediate energy electrons by HCN | S053 |
| bandstrength determination of the fundamental vibration-rotation spectrum of ClO | M010 | electron scattering by metal vapors | S064 |
| absorption strength of the perturbed ν_4 band of CH_3Cl | M012 | formation of metallic LiH | T024 |
| calculation of spin-lattice relaxation during pulsed spin locking in solids | R036 | a note on the assumption of quasiequilibrium in semiconductor junction devices | V002 |
| photoacoustic spectroscopy of organometallic compounds with applications in the fields of quasi-one-dimensional conductors and catalysis | S055 | a simple theory of back surface field (BSF) solar cells | V022 |
| optical, spin-resonance, and magnetoresistance studies of $(\text{tetrathiatetracene})_2(\text{iodide})_3$, the nature of the ground state | S056 | recombination-generation currents in degenerate semiconductors | V023 |
| elastic scattering of intermediate energy electrons by HCN.... | S064 | analysis of the interaction of an electron beam with a solar cell—I | V025 |
| electron-impact cross sections for Cu atoms .. | T027 | analysis of the interaction of an electron beam with a solar cell—II | V026 |
| formation of metallic LiH .. | V002 | electron scattering by highly polar molecules II LiF | V027 |
| physics and chemistry of MoS_2 intercalation compounds . | W046 | fourth-order acoustic torque in intense sound fields | V029 |
| electron trapping and transport by supersonic solitons in one-dimensional systems | Z004 | electron impact excitation of magnesium at 10, 20 and 40 eV impact energies.. | W008 |
| Physical Oceanography | | elastic and inelastic scattering of electrons by atomic manganese .. | W031 |
| Seasat-A opens new phase in Earth observations | C053 | a Schottky-barrier solar cell on sliced polycrystalline GaAs | W032 |
| a microwave pressure sounder .. | F025 | Pioneer Project | |
| a distributed microprocessor system for topographic imaging of the ocean floor .. | H010 | Pioneer mission support | Y005 |
| detection and interpretation of ocean roughness variations across the gulf stream inferred from radar cross section observations | W017 | ground tracking system phase fluctuation spectra..... | A007 |
| Physics (General) | | DSN radio science system, Mark III-78 | J042 |
| new technique for single-scan T_1 measurements using solid echoes .. | B077 | Pioneer Venus mission support | B033 |
| cross sections for electron impact of N_2 | C007 | Pioneer Venus 1978 Deep Space Network telecommunications compatibility test program status | B041 |
| electron-impact excitation of the low-lying electronic states of HCN .. | C027 | predetection telemetry analog recording and playback for Pioneer Venus 1978 .. | B057 |
| on the crystal phases of $(\text{DEPE}) (\text{TCNQ})_4$.. | C035 | implementation of the radio science subsystem in the DSN. | B068 |
| JPL basic research review | J027 | Pioneer Venus 1978 mission support .. | K015 |
| | | | K018 |
| | | | M049 |

| Subject | Entry | Subject | Entry |
|--|-------|--|-------|
| Pioneer 10 and 11 mission support | M050 | electrical characteristics of Spectrolab BSF 200-micron Helios cells as a function of intensity and temperature | D040 |
| observations of the interplanetary sector structure up to heliographic latitudes of 16° | | | |
| Pioneer 11 | S041 | environmental testing of flat plate solar cell modules | G038 |
| Pioneer 10, 11 observations of evolving solar wind streams and shocks beyond 1 AU | S042 | siting issues for solar thermal power plants with small community applications | H042 |
| DSN test and training system, Mark III-77 | T015 | proceedings of the DOE chemical energy storage and hydrogen energy systems contracts review | J017 |
| S-band maser phase delay stability tests | U004 | | |
| radial dependence of solar wind properties deduced from Helios 1/2 and Pioneer 10/11 | | low-cost silicon solar array (LSSA) project quarterly report 5, for the period April 1977-June 1977 | J018 |
| radio scattering observations | W044 | | |
| Planetary Biology | | proceedings of small power systems solar electric workshop, held at Aspen, Colorado, October 10-12, 1977 executive summary | J019 |
| extraterrestrial intelligence an observational approach | M069 | proceedings of small power systems solar electric workshop, held at Aspen, Colorado, October 10-12, 1977 invited papers | J020 |
| Plasma Physics | | low-cost solar array (LSA) project quarterly report 6, for the period July 1977-September 1977 | J028 |
| an analysis of Viking S-X doppler measurements of solar wind columnar content fluctuations | C001 | low-cost solar array (LSA) project quarterly report 7, for the period October 1977-December 1977 | J031 |
| electron scattering by highly polar molecules II LiF | V029 | storage, transmission and distribution of hydrogen. | K011 |
| a preliminary model for high-power waveguide arcing and arc protection | Y007 | weight propagation and equivalent horsepower for alternate-engined cars | K025 |
| Plastics | | a market survey of geothermal wellhead power generation systems final report | L024 |
| continuous extrusion of coal | E017 | waste heat recovery in truck engines | L028 |
| development and evaluation of elastomeric materials for geothermal applications—annual report, October 1976–October 1977 | M066 | the engineering analysis of solar radiation | R013 |
| Power Sources | | the effects of copper and titanium on silicon solar cells | S001 |
| proceedings of the alternate energy systems seminar | A014 | some failure modes and analysis techniques for Terrestrial solar cell modules | S022 |
| high-power, ultralow-mass solar arrays FY-77 solar arrays technology readiness assessment report (Volume I) | C041 | a simple theory of back surface field (BSF) solar cells | V023 |
| high-power, ultralow-mass solar arrays FY-77 solar arrays technology readiness assessment report (Volume II) | C042 | a Schottky-barrier solar cell on sliced polycrystalline GaAs | Y005 |
| effect of multiblade slurry saw induced damage on silicon solar cells | D006 | Propulsion and Fuels (General) | |
| effect of copper impurity on polycrystalline silicon solar cells | D007 | hydrogen enrichment for low-emission jet combustion | C030 |
| potential for cogeneration of heat and electricity in California industry—Phase I final report | D010 | nitramine smokeless propellant research—annual research progress report | C032 |
| electrical characteristics of Solarex 50-micron solar cells as a function of intensity and temperature | D038 | waste heat recovery in truck engines | L028 |
| electrical characteristics of OCLI hybrid MLAR solar cells as a function of intensity and temperature | D039 | Pumps, Filters, Pipes, Fittings, Tubing, and Valves | |
| | | new method of feeding coal continuous extrusion of fully plastic coal | R066 |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| Quality Assurance and Reliability | | Solar Physics | |
| preliminary analysis of the impact of power cycling on CTA-21 equipment reliability | C034 | electron density and doppler RMS phase fluctuation in the inner corona | B035 |
| strain energy function of styrene butadiene rubber and the effect of temperature | G020 | an analysis of Viking S-X doppler measurements of solar wind columnar content fluctuations | C001 |
| environmental testing of flat plate solar cell modules | G038 | characterization of solar cells for space applications electrical characteristics of OCLI violet solar cells as a function of intensity and temperature | C008 |
| economic evaluation of DSS 13 unattended operations demonstration | R020 | electrical characteristics of Solarex 50-micron solar cells as a function of intensity and temperature | D038 |
| fault-tolerant building-block computer study results of the 1974 through 1977 NASA/JPL balloon flight solar cell calibration program | R023 | electrical characteristics of OCLI hybrid MLAR solar cells as a function of intensity and temperature | D039 |
| | S023 | electrical characteristics of Spectrolab BSF 200-micron Helios cells as a function of intensity and temperature | D040 |
| Quantum Theory | | Helios mission support | G025 |
| quantum statistical theory of semiconductor junctions in thermal equilibrium | V024 | | G026 |
| electron trapping and transport by supersonic solitons in one-dimensional systems | Z004 | | G028 |
| | | | G030 |
| Radar Detection | | | J026 |
| planetary benchmarks | U002 | | K013 |
| | | | L015 |
| Reliability | | | N007 |
| a preliminary model for high-power waveguide arcing and arc protection | Y007 | a close-up of the sun | S041 |
| | | analysis and tests of a wide angle radiometer viewlimiter | W036 |
| Research and Support Facilities | | an alternate technique for near-Sun ranging the energetic particle environment of the solar probe mission—as estimated by the participants in the solar probe environment workshop | |
| analysis of DOT near-term transportation research, development, and demonstration activities. | B004 | observations of the interplanetary sector structure up to heliographic latitudes of 16° Pioneer 11 | |
| | | accurate solar “constant” determinations by cavity pyrheliometers | |
| Rocket Motors and Engines | | | |
| an investigation of the side force that is sometimes observed in rocket start-up | B058 | Solid Mechanics | |
| | | storage of solid propellants in a dry environment | U001 |
| Rocket Propellants | | | |
| storage of solid propellants in a dry environment | U001 | Solid-State Physics | |
| an assessment of an F ₂ or N ₂ O ₄ atmospheric injection from an aborted space shuttle mission | W010 | a multiple pulse zero crossing NMR technique, and its application to ¹⁹ F chemical shift measurements in solids | B076 |
| | | new technique for single-scan T ₁ measurements using solid echoes | B077 |
| Rubbers | | characterization of solar cells for space applications electrical characteristics of OCLI violet solar cells as a function of intensity and temperature | C008 |
| strain energy function of styrene butadiene rubber and the effect of temperature. | G020 | on the crystal phases of (DEPE) (TCNQ) ₄ | C035 |
| | | | |
| Safety Engineering | | | |
| application of the relative energy release criteria to enclosure fire testing | R052 | | |
| | | | |
| Snow, Ice, Permafrost | | | |
| synth aperture radar imagery of AIDJEX triangle | B069 | | |
| computer processing of SAR L-band imagery | B070 | | |

| Subject | Entry | Subject | Entry |
|--|-------|--|-------|
| electrical characteristics of Solarex 50-micron solar cells as a function of intensity and temperature | D038 | the energetic particle environment of the solar probe mission—as estimated by the participants in the solar probe environment workshop | N007 |
| electrical characteristics of OCLI hybrid MLAR solar cells as a function of intensity and temperature | D039 | Pioneer 10, 11 observations of evolving solar wind streams and shocks beyond 1 AU | S042 |
| electrical characteristics of Spectrolab BSF 200-micron Helios cells as a function of intensity and temperature. | D040 | Voyager electronic parts radiation program test requirements and procedures | S070 |
| wide area detection system conceptual design study | H031 | Space Sciences (General) | |
| a transform-pair relationship between incident and scattered fields from an arbitrary reflector | L054 | an interpretation of Mariner 10 helium (584 Å) and hydrogen (1216 Å) interplanetary emission observations | A009 |
| calculation of spin-lattice relaxation during pulsed spin locking in solids | R036 | tests of general relativity using astrometric and radio metric observations of the planets | A017 |
| optical, spin-resonance, and magnetoresistance studies of (tetrathiatetracene) ₂ (iodide) ₃ , the nature of the ground state | S056 | missions to comets an options review | A024 |
| electrical properties of (DEPE) (TCNQ) ₄ | S057 | future of synthetic aperture radar | B005 |
| formation of metallic LiH | V002 | a brief historical introduction to very long baseline interferometry | B023 |
| determination of bulk diffusion lengths for angle-lapped semiconductor material via the scanning electron microscope—a theoretical analysis. | V021 | an extensive bibliography on long baseline interferometry | B024 |
| a note on the assumption of quasiequilibrium in semiconductor junction devices | V022 | deep space telecommunications and the solar cycle a reappraisal | B032 |
| quantum statistical theory of semiconductor junctions in thermal equilibrium | V024 | system performance testing of the DSN radio science system, Mark III-78 | B034 |
| recombination-generation currents in degenerate semiconductors. | V025 | electron density and doppler RMS phase fluctuation in the inner corona | B035 |
| analysis of the interaction of an electron beam with a solar cell—I | V026 | the DSS radio science subsystem—real-time bandwidth reduction and wideband recording of radio science data | B036 |
| analysis of the interaction of an electron beam with a solar cell—II | V027 | solar wind density fluctuation and the experiment to detect gravitational waves in ultraprecise doppler data | B037 |
| physics and chemistry of MoS ₂ intercalation compounds | W046 | solar wind turbulence models evaluated via observations of doppler RMS phase fluctuation and spectral broadening in the inner corona | B038 |
| a Schottky-barrier solar cell on sliced polycrystalline GaAs | Y005 | DSN radio science system, Mark III-78 | B041 |
| electron trapping and transport by supersonic solitons in one-dimensional systems | Z004 | radio science requirements and the end-to-end ranging system | B042 |
| Space Radiation | | parametric modeling of low-frequency water-vapor-induced tropospheric path length fluctuations | B043 |
| Helios mission support | G028 | simultaneous dual-frequency, round-trip calibration of Doppler data with application to radio science experiments | B044 |
| a close-up of the sun | J026 | a solar wind turbulence event during the Voyager 1978 solar conjunction profiled via a new DSN radio science data capability | B045 |
| evidence of an increase in the microwave brightness temperature of Uranus | K021 | | |
| identification of water frost on Callisto | L019 | | |
| a search for the reported 400-keV γ-ray line from crab nebula. | L041 | | |

| Subject | Entry | Subject | Entry |
|--|---------|---|-------|
| radial and solar cycle variations in the solar wind phase fluctuation spectral index as determined from Voyager 1978 solar conjunction data | | compilation of wind tunnel coefficients for parabolic reflectors | L033 |
| a parameter estimation subroutine package | B046 | enhancement of the jets in NGC 1097 | L052 |
| Mars topography harmonics and geophysical implications | B050 | on the accelerations of the Moon and Sun, the constant of gravitation, and the origin of mountains | L060 |
| an analysis of Viking S-X doppler measurements of solar wind columnar content fluctuations | B054 | soil maturity and planetary regoliths the Moon, Mercury, and the asteroids | M019 |
| sodium D-line emission from Io comparison of observed and theoretical line profiles | C001 | asteroids and comparative planetology | M022 |
| the mass of Phobos from Viking flybys | C005 | infrared astronomical satellite | M036 |
| Deimos Encounter by Viking preliminary imaging results | C025 | thorium concentrations in the lunar surface I regional values and crustal content | M044 |
| spacecraft imaging of Phobos and Deimos | D047 | on a correlation between surface remanent magnetism and chemistry for the lunar frontside and limbs | M045 |
| barotropic instability in the upper atmosphere of venus | D048 | the DSN VLBI system, Mark I-79 | M067 |
| experimental determination of Mercury's mass and oblateness | E016 | postperihelion interference filter photometry of the "annual" comet P/Encke | N009 |
| Mars regolith adsorption and the relative concentrations of atmospheric rare gases . | E023 | equipotential doming in flooded circular basins on the Moon | R055 |
| Mars the role of the regolith in determining atmospheric pressure and the atmosphere's response to insolation changes | ...F001 | Venus geologic analysis of radar images | S004 |
| the isostatic state of the lunar apennines and regional surroundings | F002 | Venus cloud structure and water vapor abundance from Mariner 10 observations | T007 |
| the ISEE-C vector helium magnetometer | F013 | the puzzling moons of Mars | V017 |
| preliminary studies of electromagnetic sounding of cometary nuclei | F028 | comet Tempel 2 orbit, ephemerides and error analysis | Y011 |
| evidence for the depletion of ammonia in the Uranus atmosphere | G001 | solar heating of the Martian dusty atmosphere | Z010 |
| testing relativistic theories of gravity with spacecraft-Doppler gravity-wave detection | G040 | Spacecraft Communications, Command, and Tracking | |
| broad perspectives in radar for ocean measurements | H020 | DSN water vapor radiometer development— recent work, 1978 | B012 |
| interplanetary approach optical navigation with applications | J007 | an analysis of alternate symbol inversion for improved symbol synchronization in convolutionally coded systems | B014 |
| upper atmosphere research satellite program final report of the science working group | J016 | deep space telecommunications and the solar cycle: a reappraisal | B032 |
| a close-up of the sun | J024 | ground tracking system phase fluctuation spectra | B033 |
| the Galilean satellites of Jupiter four worlds | J026 | system performance testing of the DSN radio science system, Mark III-78 | B034 |
| lunar spectral units a northern hemispheric mosaic | J032 | electron density and doppler RMS phase fluctuation in the inner corona | B035 |
| a TiO ₂ abundance map for the northern maria | J036 | the DSS radio science subsystem—real-time bandwidth reduction and wideband recording of radio science data | B036 |
| implementation of the radio science subsystem in the DSN | J037 | solar wind density fluctuation and the experiment to detect gravitational waves in ultraprecise doppler data | B037 |
| Jupiter's atmosphere observations and interpretation of the microwave spectrum near 1.25-cm wavelength | K018 | solar wind turbulence models evaluated via observations of doppler RMS phase fluctuation and spectral broadening in the inner corona | B038 |
| | K022 | | |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| the gravitational wave detection experiment description and anticipated requirements. | B039 | testing relativistic theories of gravity with spacecraft-Doppler gravity-wave detection | H020 |
| the DSS radio science subsystem—data handling of very long baseline interferometry (VLBI) data | B040 | a new, nearly free, clock synchronization technique | H028 |
| simultaneous dual-frequency, round-trip calibration of Doppler data with application to radio science experiments | B044 | use of a priori statistics to minimize acquisition time for RFI immune spread spectrum systems | H044 |
| a solar wind turbulence event during the Voyager 1978 solar conjunction profiled via a new DSN radio science data capability .. | B045 | orbiting deep space relay station, a study report | H054 |
| radial and solar cycle variations in the solar wind phase fluctuation spectral index as determined from Voyager 1978 solar conjunction data | B046 | Pioneer mission support | J042 |
| Pioneer Venus mission support | B057 | an alternate technique for near-Sun ranging on improved ranging | L015 |
| radio-frequency carrier arraying for high-rate telemetry reception | B064 | tracking loop and modulation format considerations for high rate telemetry | L029 |
| Δ VLBI spacecraft tracking system demonstration: Part I. design and planning | B066 | compilation of wind tunnel coefficients for parabolic reflectors | L033 |
| Pioneer Venus 1978 Deep Space Network telecommunications compatibility test program status... | B068 | on the determination and investigation of the terrestrial ionospheric refractive indices using GEOS-3/ATS-6 satellite-to-satellite tracking data | L044 |
| a demonstration of differenced dual-station one-way doppler conducted with Pioneer 11 | C014 | application of Kalman filtering to spacecraft range residual prediction | M001 |
| large active retrodirective arrays for space applications | C021 | DSN system performance test software | M014 |
| microwave radiometer measurement of water vapor path delay data reduction techniques ... | C029 | Pioneer Venus 1978 mission support | M049 |
| CCIR papers on telecommunications for deep space research.. .. . | D013 | Pioneer 10 and 11 mission support | M050 |
| | D015 | a tutorial introduction to very long baseline interferometry (VLBI) using bandwidth synthesis | M058 |
| radio frequency interference between spacecraft in different missions | D014 | Voyager support | M062 |
| multilaterating the GEOS-3 satellite | E022 | tracking and data system support for the Viking 1975 mission to Mars: extended mission operations December 1976 to May 1978 | M065 |
| Viking extended mission support. | G016 | the DSN VLBI system, Mark I-79 | M067 |
| | G017 | updated Z-corrections for 64-m DSS ground station delay calibrations | O012 |
| | G018 | hydrogen maser frequency standard computer model for automatic cavity tuning servo simulations | P023 |
| | H045 | an entree for large space antennas | P025 |
| | H046 | establishing a celestial VLBI reference frame—I searching for VLBI sources | P028 |
| Viking continuation mission support | G019 | on estimating the phase of a periodic waveform in additive gaussian noise—Part I.. . . | R003 |
| Helios mission support | G025 | network functions and facilities | R027 |
| | G026 | | R028 |
| | G027 | | R029 |
| | G029 | | R030 |
| | G030 | | R031 |
| dual-frequency feed cone assemblies for 34-meter antennas | H012 | | R032 |
| attitude determination system for a nadir-pointing satellite. | H014 | | |

| Subject | Entry | Subject | Entry |
|---|-------|---|-------|
| network telemetry system performance tests in support of the Mark III data system implementation | R034 | reconfigurable modular computer networks for spacecraft on-board processing | R024 |
| potential end-to-end imaging information rate advantages of various alternative communication systems | R039 | a distributed microprocessor system for spacecraft control and data handling | R025 |
| RPV application of a globally adaptive rate controlled compressor | R040 | system design of an ion drive spacecraft | S089 |
| an empirical spectral bandwidth model for superior conjunction | R048 | Spacecraft Instrumentation | |
| an algorithm for generating an <i>m</i> -ary summation tree | S026 | application of CCD technology to produce imagery from radar data | A021 |
| a review of the state of the art in large spaceborne antenna technology | S039 | future of synthetic aperture radar | B005 |
| Voyager near simultaneous ranging transfers | S060 | Seasat-A opens new phase in Earth observations | C053 |
| Deep Space Network to Viking Orbiter telecommunications performance during the Viking extended mission, November 1976 through February 1978 | T005 | spacecraft imaging of Phobos and Deimos | D048 |
| DSN "load and go" pre-track preparation for Voyager support | T009 | new concepts for Mercury orbiter missions | F031 |
| DSN test and training system, Mark III-77 | T015 | attitude determination system for a nadir-pointing satellite | H014 |
| S-band maser phase delay stability tests | U004 | broad perspectives in radar for ocean measurements | J007 |
| tracking operations during the Voyager 2 launch phase | W001 | upper atmosphere research satellite program final report of the science working group | J024 |
| DSN 100-meter X- and S-band microwave antenna design and performance | W033 | a close-up of the sun | J026 |
| Spacecraft Design, Testing, and Performance | | bandwidth compression of synthetic aperture radar imagery by quantization of raw radar data | L042 |
| spacecraft subsystem checkout by minicomputer | A016 | Spacecraft Propulsion and Power | |
| characterization of solar cells for space applications electrical characteristics of OCLI violet solar cells as a function of intensity and temperature | C008 | the ion drive program competition as the key to development progress | A025 |
| summary of Voyager design and flight loads | C018 | an investigation of the side force that is sometimes observed in rocket start-up | B058 |
| launch vehicle payload interface response | C020 | high-power, ultralow-mass solar arrays FY-77 solar arrays technology readiness assessment report (Volume I) | C041 |
| a highly accurate method for the determination of mass and center of mass of a spacecraft | C022 | high-power, ultralow-mass solar arrays FY-77 solar arrays technology readiness assessment report (Volume II) | C042 |
| electrical characteristics of Solarex 50-micron solar cells as a function of intensity and temperature | D038 | microwave power transmitting phased array antenna research project summary report | D025 |
| electrical characteristics of OCLI hybrid MLAR solar cells as a function of intensity and temperature | D039 | parametric study of two planar high power flexible solar array concepts | G008 |
| electrical characteristics of Spectrolab BSF 200-micron Helios cells as a function of intensity and temperature | D040 | sialons as high temperature insulators | P016 |
| new concepts for Mercury orbiter missions | F031 | results of the 1974 through 1977 NASA/JPL balloon flight solar cell calibration program | S023 |
| attitude determination system for a nadir-pointing satellite | H014 | space power systems technology enablement study | S047 |
| lateral forces induced by a misaligned roller | M033 | system design of an ion drive spacecraft | S089 |
| Pioneer 10 and 11 mission support | M050 | storage of solid propellants in a dry environment | U001 |
| | | a simple theory of back surface field (BSF) solar cells | V023 |
| | | an assessment of an F ₂ or N ₂ O ₄ atmospheric injection from an aborted space shuttle mission | W010 |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| Statistics and Probability | | utilization of waste heat in trucks for increased fuel economy | L027 |
| a statistical, micromechanical theory of the compressive strength of brittle materials | A004 | LAASP 100-m antenna wind performance studies | L034 |
| stochastic processes, estimation theory, and image enhancement | A022 | Subsystems | |
| a probabilistic version of Sperner's Theorem, with applications to the problem of retrieving information from a data base | B015 | a review of the state of the art in large spaceborne antenna technology | S039 |
| applications of modern estimation techniques to aircraft navigation | B053 | Systems Analysis | |
| preliminary analysis of the impact of power cycling on CTA-21 equipment reliability | C034 | a survey of electric and hybrid vehicle simulation programs final report | B047 |
| a probabilistic model of insolation for the Mojave desert area | H024 | performance of solar-powered vapor-jet refrigeration systems with selected working fluids | C010 |
| use of a priori statistics to minimize acquisition time for RFI immune spread spectrum systems | H044 | the Otto-engine-equivalent vehicle concept | D036 |
| LAASP 100-m antenna wind performance studies | L034 | a new, nearly free, clock synchronization technique | H028 |
| a closed network queue model of underground coal mining production, failure, and repair | L047 | interplanetary approach optical navigation with applications | J018 |
| preliminary design work on a DSN VLBI correlator | L055 | JPL energy consumption program (ECP) documentation: a computer model simulating heating, cooling and energy loads in buildings | L004 |
| a property of Euclid's algorithm and an application to Pade approximation | M031 | development of a unified criterion for solar collector selection | L005 |
| CCIR paper on the radiocommunications requirements for systems to search for extraterrestrial life | N013 | tracking loop and modulation format considerations for high rate telemetry | L029 |
| linear stochastic control using the UDU^T matrix factorization | T016 | a closed network queue model of underground coal mining production, failure, and repair | L047 |
| statistical error analysis using the UDU^T covariance factorization | T018 | codes arising from non-abelian group algebras | M048 |
| Stress Physiology | | economic evaluation of DSS 13 unattended operations demonstration | R020 |
| effect of ultrasonic irradiation on mammalian cells and chromosomes <i>in vitro</i> | R053 | network telemetry system performance tests in support of the Mark III data system implementation | R034 |
| Structural Engineering | | potential end-to-end imaging information rate advantages of various alternative communication systems | R039 |
| analysis of heat losses and casing temperatures of steam injection wells with annular coolant water flow | B002 | RPV application of a globally adaptive rate controlled compressor | R040 |
| summary of Voyager design and flight loads | C018 | an effective procurement and financial management reporting system | R056 |
| launch vehicle payload interface response | C020 | some data relationships among diverse areas of the DSN and JPL | S048 |
| solar energy for process heat design/cost studies of four industrial retrofit applications | F032 | energy consumption program—a computer model simulating energy loads in buildings | S085 |
| parametric study of two planar high power flexible solar array concepts | G008 | SEASAT-A Project | |
| NASTRAN analysis of a wheel-rail loading on its foundation | K007 | attitude determination system for a nadir-pointing satellite | H014 |
| structural design of a 64-meter low-cost antenna | K009 | optimal sampling and quantization of synthetic aperture radar signals | W048 |

| Subject | Entry | Subject | Entry |
|--|-------|---|-------|
| Theoretical Mathematics | | Mars regolith adsorption and the relative concentrations of atmospheric rare gases | F001 |
| a probabilistic version of Sperner's Theorem, with applications to the problem of retrieving information from a data base | B015 | Mars water vapor observations from the Viking orbiters | F006 |
| on the fundamental structure of Galois switching functions | B025 | Viking radio occultation measurements of the Martian atmosphere and topography primary mission coverage | F023 |
| the Lovasz bound and some generalizations | M027 | Viking extended mission support | G016 |
| a game with n numbers | M047 | | G017 |
| necklaces, symmetries and self-reciprocal polynomials | M052 | | G018 |
| | | | G018 |
| Thermodynamics and Statistical Physics | | | H046 |
| strain energy function of styrene butadiene rubber and the effect of temperature | G020 | Viking continuation mission support | G019 |
| optical, spin-resonance, and magnetoresistance studies of (tetrathiatetracene) ₂ (iodide) ₃ , the nature of the ground state | S056 | Viking image processing | G034 |
| quantum statistical theory of semiconductor junctions in thermal equilibrium | V024 | orbit trim maneuver design and implementation for the 1975 Mars Viking mission | H035 |
| electron trapping and transport by supersonic solitons in one-dimensional systems | Z004 | inflight performance of the Viking visual imaging subsystem | K020 |
| | | processing the Viking lander camera data | L032 |
| | | Viking 1975 Mars lander interactive computerized video stereophotogrammetry | L035 |
| Urban Technology and Transportation | | tracking and data system support for the Viking 1975 mission to Mars extended mission operations December 1976 to May 1978 | M065 |
| analysis of DOT near-term transportation research, development, and demonstration activities | B004 | | O002 |
| fully automated urban traffic system | D029 | an overview of Viking navigation | |
| evaluation of FIDC system final report | H006 | the composition of Phobos evidence for carbonaceous chondrite surface from spectral analysis | P002 |
| siting issues for solar thermal power plants with small community applications | H042 | multicolor observations of Phobos with the Viking lander cameras evidence for a carbonaceous chondritic composition | P019 |
| automated mixed traffic vehicle (AMTV) technology and safety study | J040 | thermal resistance of naturally occurring airborne bacterial spores | P032 |
| utilization of waste heat in trucks for increased fuel economy | L027 | IPL processing of the Viking orbiter images of Mars | R058 |
| historical evidence of importance to the industrialization of flat-plate silicon photovoltaic systems executive summary | S045 | the missions of the Viking orbiters | S050 |
| historical evidence of importance to the industrialization of flat-plate silicon photovoltaic systems | S046 | Deep Space Network to Viking Orbiter telecommunications performance during the Viking extended mission, November 1976 through February 1978 | T005 |
| Viking Mars 1975 Project | | Viking orbiter observations of atmospheric opacity during July–November 1976 | T020 |
| a demonstration of dual spacecraft tracking conducted with the Viking spacecraft during the approach phase | C012 | Viking orbiter photometric observations of the Mars phase function July through November 1976 | T021 |
| launch vehicle payload interface response | C020 | Viking first encounter of Phobos preliminary results | T022 |
| the mass of Phobos from Viking flybys | C025 | Viking observations of Phobos and Deimos preliminary results | V013 |
| Viking imaging of Phobos and Deimos | D044 | the puzzling moons of Mars | V017 |
| Phobos transit of Mars as viewed by the Viking cameras | D046 | | |
| Deimos Encounter by Viking preliminary imaging results | D047 | | |

| Subject | Entry | Subject | Entry |
|---|-------|--|-------|
| Voyager Project | | | |
| DSN radio science system, Mark III-78 | B041 | new X-band microwave equipment at the DSN 64-meter stations | H011 |
| a solar wind turbulence event during the Voyager 1978 solar conjunction profiled via a new DSN radio science data capability | B045 | dual-frequency feed cone assemblies for 34- meter antennas | H012 |
| radial and solar cycle variations in the solar wind phase fluctuation spectral index as determined from Voyager 1978 solar conjunction data. | B046 | Voyager electronic parts radiation program test requirements and procedures | S070 |
| summary of Voyager design and flight loads | C018 | Wave Propagation | |
| | | a prototype DSN X-S band feed DSS 13 application status (second report) | W035 |

Publication Index

JPL Publications

| Number | Entry | Number | Entry |
|----------------|-------|---------------|-------|
| 33-783, Vol IV | M065 | 42-44 (contd) | M062 |
| 33-806 | F029 | | O009 |
| 42-43. | B032 | | R006 |
| | B033 | | R028 |
| | B034 | | R056 |
| | C012 | | S012 |
| | C013 | | S048 |
| | D013 | | S060 |
| | D014 | | T012 |
| | E005 | | T015 |
| | E027 | | W001 |
| | G010 | | W034 |
| | G025 | 42-45 | W038 |
| | H045 | | B017 |
| | K007 | | B064 |
| | K015 | | B066 |
| | L055 | | B068 |
| | M014 | | C014 |
| | P005 | | F024 |
| | R004 | | G016 |
| | R005 | | G027 |
| | R027 | | G036 |
| | R048 | | K009 |
| | S077 | | K018 |
| | S079 | | M008 |
| | W050 | | M027 |
| 42-44 | A007 | | M033 |
| | A012 | | M049 |
| | B014 | | N013 |
| | B035 | | R003 |
| | B036 | | R007 |
| | B037 | | R008 |
| | B038 | | R020 |
| | C001 | | R029 |
| | C010 | | R034 |
| | D015 | | S026 |
| | G026 | | S085 |
| | H028 | | T005 |
| | H046 | 42-46 | T009 |
| | J001 | | B015 |
| | L005 | | B023 |
| | L015 | | B024 |
| | L029 | | B039 |
| | L034 | | B040 |
| | M028 | | C034 |
| | | | D031 |

JPL Publications (contd)

| Number | Entry | Number | Entry |
|---------------|-------|----------------|-------|
| 42-46 (contd) | F030 | 43-29, Part II | T003 |
| | G017 | | |
| | G028 | 77-26, Rev 2 | B050 |
| | H044 | 77-32 | .K019 |
| | J042 | | |
| | L016 | 77-41, Vol II | S070 |
| | M034 | 77-47 | H036 |
| | M058 | | |
| | M061 | 77-48 | S009 |
| | M067 | | |
| | M068 | 77-49 | S010 |
| | P013 | 77-64 | D029 |
| | P028 | | |
| | R009 | 77-76 | H038 |
| | R030 | | |
| | S016 | 77-77 | H039 |
| | W006 | 77-80 | M056 |
| 42-47 | B016 | 77-81 | W010 |
| | B041 | | |
| | B042 | 77-82 | S023 |
| | B043 | | |
| | G018 | 77-83 | A001 |
| | G029 | 78-1 | J017 |
| | G035 | | |
| | H012 | 78-2 | C022 |
| | L046 | | |
| | L056 | 78-3 | H005 |
| | M050 | 78-4 | J007 |
| | O012 | | |
| | P023 | 78-5 | B010 |
| | R031 | | |
| | W035 | 78-6 | C032 |
| 42-48 | B012 | 78-7 | S047 |
| | B044 | 78-8 | K004 |
| | B045 | | |
| | B046 | 78-9 | J018 |
| | B057 | 78-10, Vol. I | J019 |
| | C029 | | |
| | G019 | 78-10, Vol II | J020 |
| | G030 | | |
| | H011 | 78-11 | H024 |
| | H053 | 78-12 | J040 |
| | I003 | | |
| | L017 | 78-13 | M009 |
| | M016 | 78-14 | J021 |
| | P012 | | |
| | R010 | 78-15, Vol. I | C008 |
| | R032 | | |
| | R035 | 78-15, Vol. II | D038 |
| | S080 | 78-15, Vol III | D039 |
| | U004 | | |
| | Y007 | 78-15, Vol IV | D040 |

JPL Publications (contd)

| Number | Entry | Number | Entry |
|-------------------------|-------|-------------------------|-------|
| 78-16 | L033 | 78-54 | J024 |
| 78-17 | L050 | 78-55 | A024 |
| 78-18 | O001 | 78-56 | J025 |
| 78-19 | D001 | 78-58, Vol I | B047 |
| 78-20 | C021 | 78-60 | S084 |
| 78-21 | D034 | 78-61 | R040 |
| 78-22 | J006 | 78-63 | K013 |
| 78-25 | F032 | 78-64 | N007 |
| 78-26 | L012 | 78-65 | W033 |
| 78-28 | D025 | 78-66, Vols I and II | C036 |
| 78-29 | L024 | 78-67 | R023 |
| 78-32 | H031 | 78-68 | F025 |
| 78-33 | B006 | 78-69 | M066 |
| 78-34 | A002 | 78-70 | J026 |
| 78-36, Vol I | S045 | 78-71, Vol I | D032 |
| 78-36, Vol II | S046 | 78-71, Vol II | D033 |
| 78-37 | C017 | 78-72 | L047 |
| 78-39 | L027 | 78-74 | C018 |
| 78-40 | J016 | 78-75 | H042 |
| 78-41 | W048 | 78-76 | L004 |
| 78-42 | D010 | 78-78 | H015 |
| 78-43 | M032 | 78-79 | J027 |
| 78-44 | G001 | 78-81 | E024 |
| 78-45 | A014 | 78-82 | F010 |
| 78-46 | J022 | 78-83 | J028 |
| 78-47 | V021 | 78-85 | Y011 |
| 78-48, Vol I | C041 | 78-86 | R052 |
| 78-48, Vol II | C042 | 78-88 | S039 |
| 78-49 | B004 | 78-89 | J029 |
| 78-50 | A022 | 78-90 | L020 |
| 78-51 | C044 | 78-91 | L051 |
| 78-52 | R039 | 78-92 | J030 |
| 78-53 | J023 | 78-93 | H006 |

JPL Publications (contd)

| Number | Entry | Number | Entry |
|-----------------|-------|------------------|-------|
| 78-94 | U002 | 78-99 | U001 |
| 78-95.. . . . | G008 | 78-101 | D036 |
| 78-97 | J031 | 78-103 | P016 |

Open Literature Reporting

| Publication | Entry | Publication | Entry |
|--|----------------------|---|--|
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| Appl Opt. | F033 K020 M010 | Computer | R024 |
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Open Literature Reporting (contd)

| Publication | Entry | Publication | Entry |
|--|--------------------------------------|--|--|
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| IEEE Trans Nucl Sci | S071 S072 | J Polym Sci Polym Phys | G020 |

Open Literature Reporting (contd)

| Publication | Entry | Publication | Entry |
|---|--|---|--|
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Open Literature Reporting (contd)

| Publication | Entry | Publication | Entry |
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